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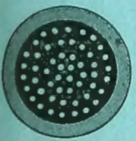

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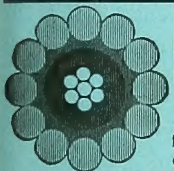

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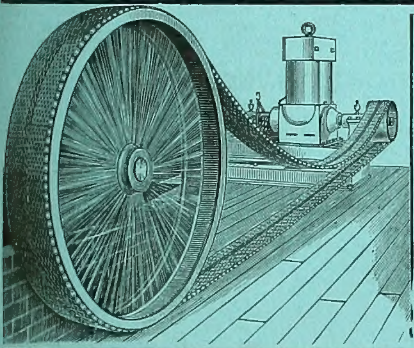

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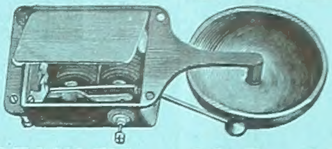
Superior to  All Others.

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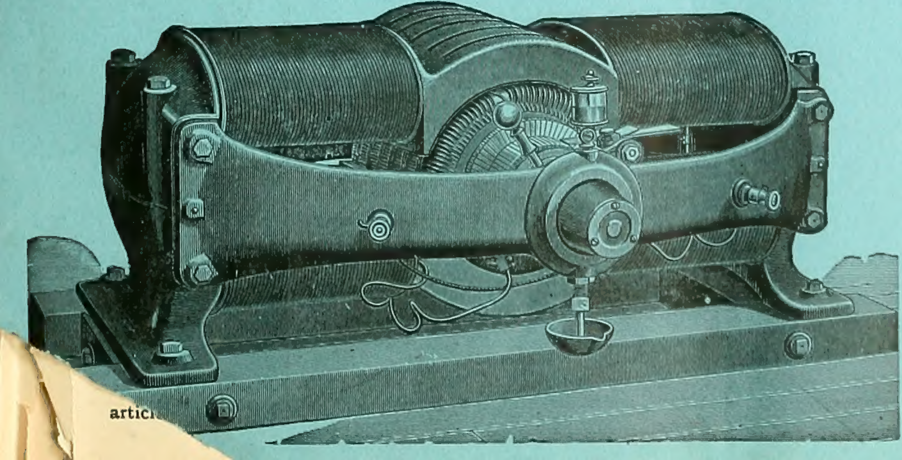

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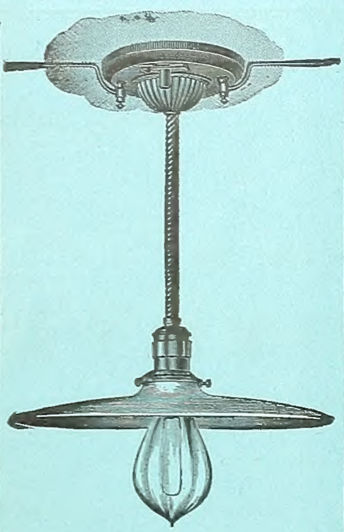

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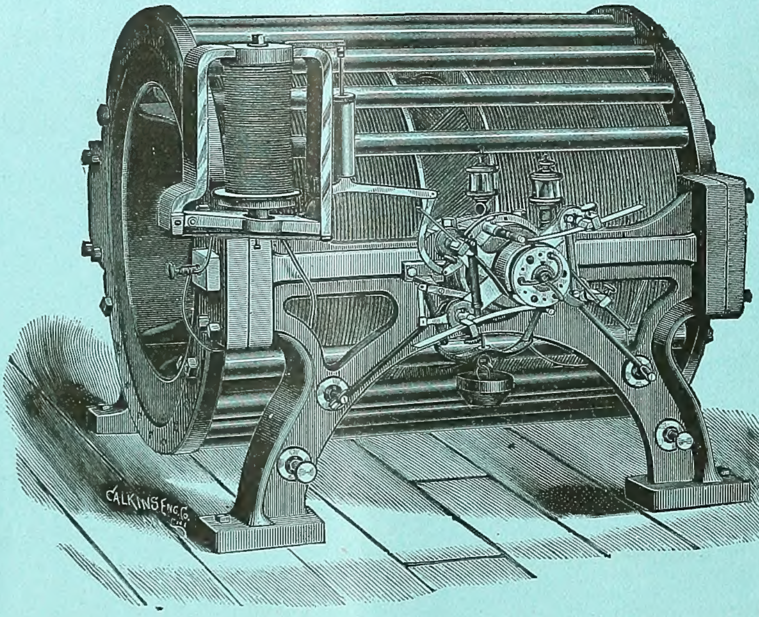

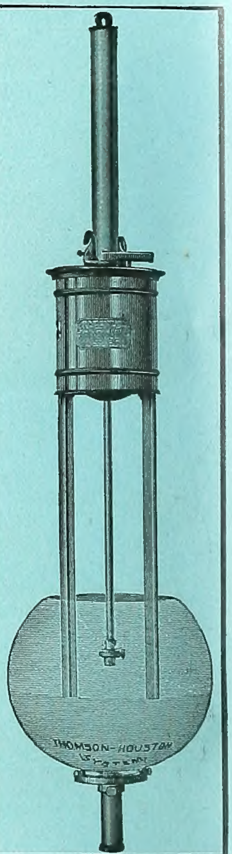

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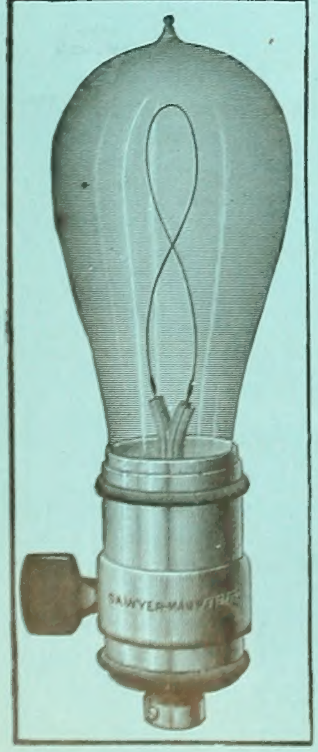

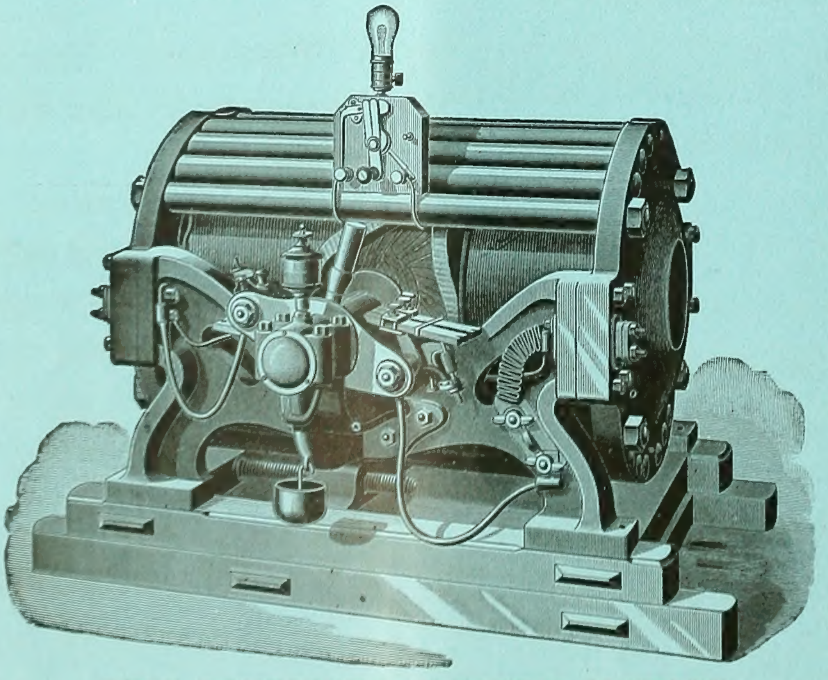

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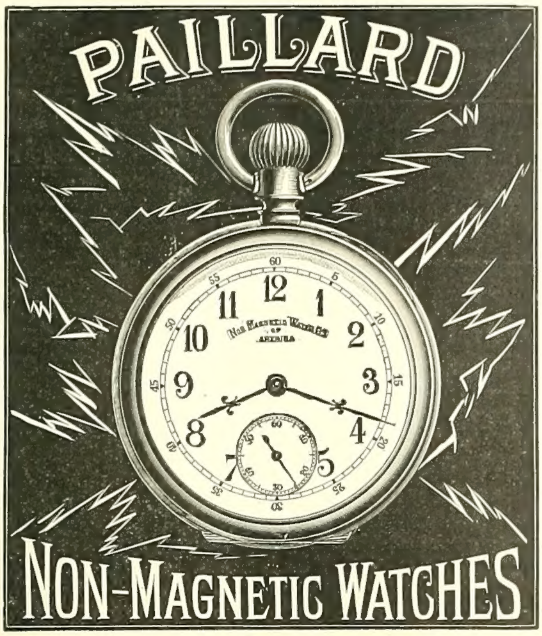

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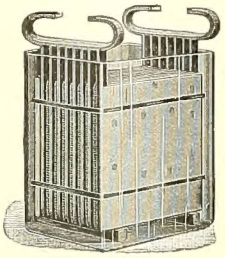

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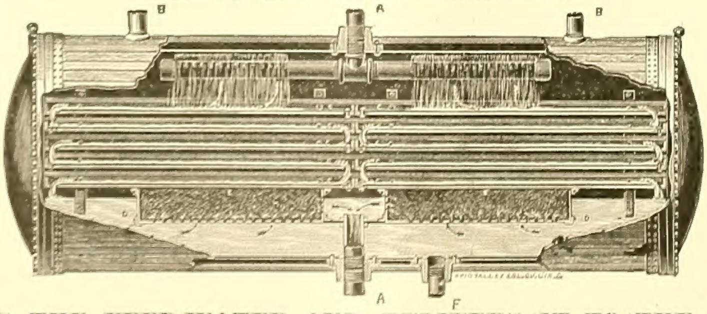

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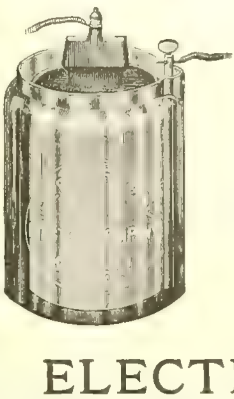

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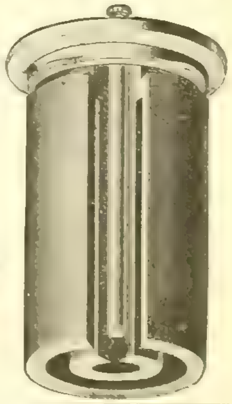

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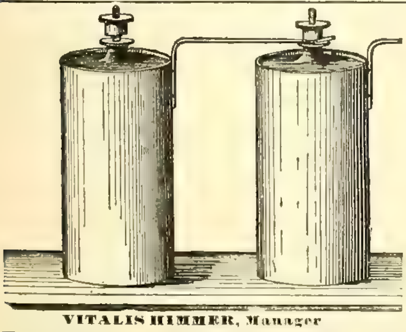

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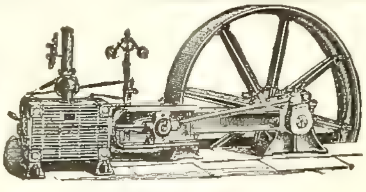

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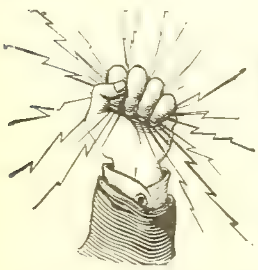

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Westinghouse Electric Co.,

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[**Manufacturers under Patents and Applications for Patents controlling the sale and use of Alternating Current Electric Lighting Apparatus and Distributing Systems.**]

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Note the sale of 132 Central Station Plants by this Company, aggregating a total generating capacity of 240,000 16-candle-power lamps, within the brief period of twenty-four months, together with the fact that out of these 132 Central Stations, 38 have increased their plant since starting.

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Small Motors for use on existing Alternating Circuits of this Company.

BELLS, BATTERIES AND PUSHES

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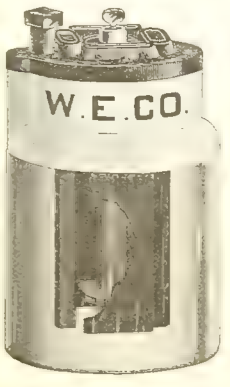
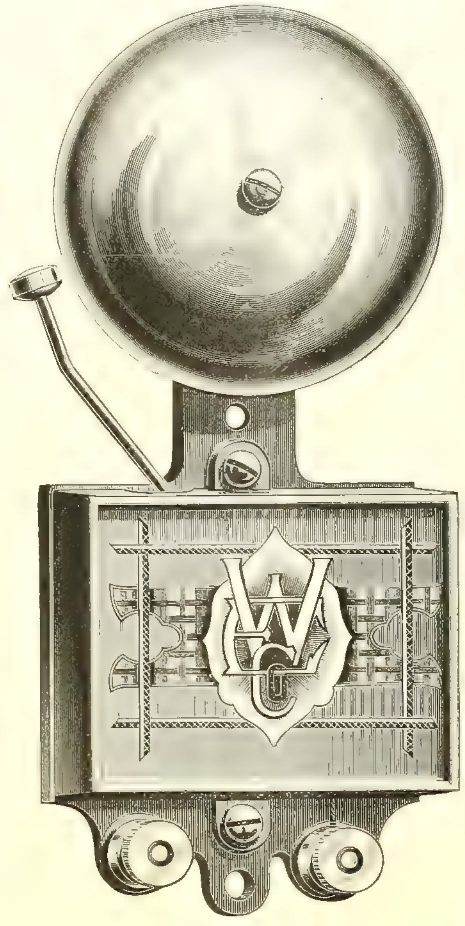


Prices upon Application.

New Style Iron Box Bell, No. 1006.



(Cut Full Size.)

Disque Battery.

Prices upon Application.

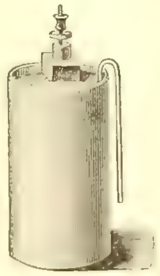
Bronze Push No. 1004.

Price, 75 Cents.

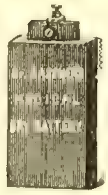
Sample Sent by Mail on Receipt of 65c.

Agents for the Gassner Dry Battery.

Oval.

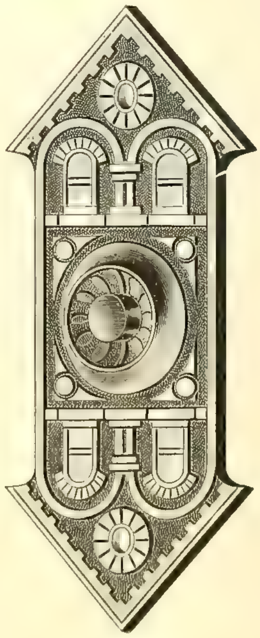


Cylindrical.



Medical.

Bronze Push No. 1003.



Price, 75 Cents.

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WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. IV. CHICAGO, JANUARY 5, 1889. No. 1

Chicago City Electric Light Plant.

The city of Chicago received a Christmas gift that will prove a lasting benefit to its citizens. For the first time in the history of the city electricity was utilized on an extensive scale for public lighting. The new system thus far has proved successful, and given entire satisfaction. The people of Chicago had not fully realized the benefits of electric lighting until the display Christmas Eve, and since then the demand for an extension of the system has been so great that it is quite probable that an additional appropriation will be demanded for this purpose.

It should be borne in mind that Chicago is the first city in the country to establish an electric light system. Other cities have purchased old overhead lines, but Chicago has begun the establishment of a permanent system, and one that will prove not only comprehensive, but, as Professor Barrett says, also inexpensive, as compared with those of other cities. The system is now the most extensive underground plant in the world employed for city lighting.

In a recent conversation, City-electrician Barrett said: "Work was begun on the system in August last. There were thirty-six miles of cable in the old, or river, plant, and we have thirty-six miles in the new street plant. All the wires are laid underground in substantial, permanent conduits, all of them constructed by the city, carried up inside the lamp posts, taking every precaution to guard against possible future danger of coming into contact with the wires. The latter are entirely out of sight and out of the way of everybody. They are insulated principally with rubber, but some with paraffine. The pipes are four inches in diameter, and from three to four wires are laid in one pipe. The conduits have been built large for the accommodation of fire, police, and all municipal purposes, and are readily accessible by manholes at convenient distances."

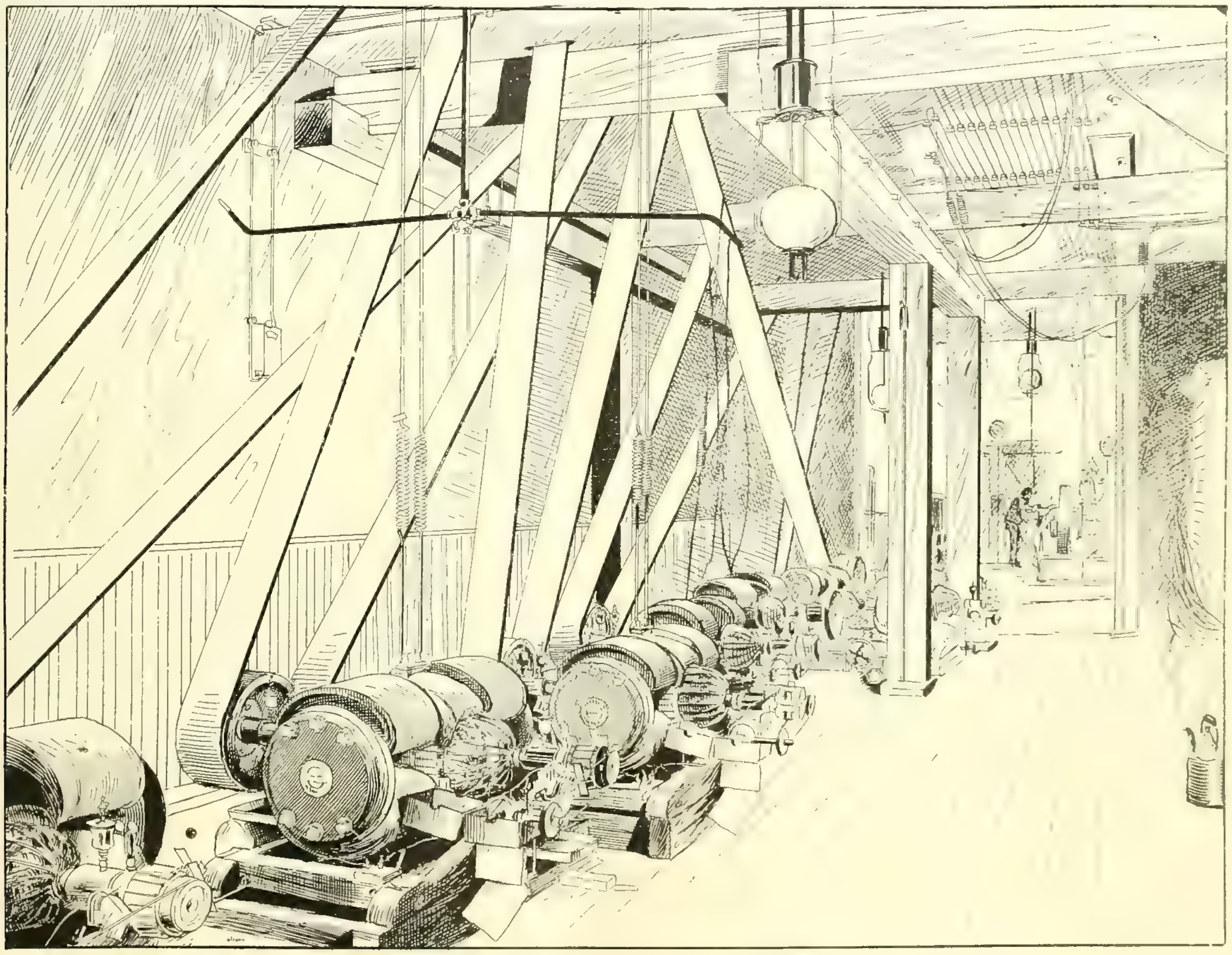
The accompanying cut illustrates the dynamo room in the power house on Jefferson street. This room contains sixteen Western Electric company's dynamos, each of a capacity of 35 lights. Of course, at present, all of these dynamos are not in use, but the present plant is merely a beginning of the work planned by Professor Barrett. The dynamos are operated by a 400 horse power automatic cut-off engine of the Wright pattern. There are three boilers and furnaces, and these, too, are of the most approved plan.

The underground circuits run to a large general switch-board of the Western Electric company type. The arrangement is such that any dynamo can be connected on any circuit in a few seconds.

In the construction of the [illegible] so laid out that in none is there a potential of over 1,000 volts. The dynamos are not connected in series, but each [illegible] cuit. This arrangement was made as the [illegible] safeguard against accidents to persons handling the lamps, machinery, and other parts of the [illegible] cuit.

The power generated at this station is conducted through underground [illegible] illuminated by this system. These in [illegible] Michigan avenue from Rush to Jackson street, Madison street from Michigan avenue to Ashland avenue, Van Buren street from Fifth avenue to Halsted street, Halsted from Van Buren to Madison, Desplaines from Van Buren to Randolph, Fifth avenue from Randolph to Van Buren, Washington from La Salle to Desplaines. These are the substantial trunk lines, on which a number of spurs run, but no additional lamps will be placed for the present. There are [illegible] lights on the bridges and viaducts which are now lit by the four dynamos at the corner of Clinton and Washington. It is intended to combine the river and street plants, gradually transferring the former to the new underground dynamo plant on Jefferson, near the corner of Van Buren street.

When the question of the comparative cost [illegible]



CHICAGO CITY ELECTRIC LIGHT PLANT.—DYNAMO ROOM.

electricity and gas was broached, Professor Barrett made the following assertion: "The displacement of gas will pay the running expenses, and leave a handsome surplus for the city. The great advantage is in the added illumination. Each of our lamps has a capacity of 2,000 candle power, while a gas lamp has but sixteen at the most. Each electric lamp displaces three to four gas lamps. Thus you will perceive that the electric system gives to the streets at least thirty times the light supplied by gas. And then, there is the advantage, no mean one, of instantaneous lighting as well as extinguishing, managed at the Jefferson street dynamo plant. The council will have abundant opportunity to judge for itself touching the merits of the electrical light system before the completion of the financial budget, which must be made by the last of March. In the meantime the people should see for themselves the value, importance and economy of the new system."

The success of the underground system is doubly gratifying to Prof. Barrett, owing to the

At a consultation of Prof. Barrett and the controller and chairman of the finance committee of the city council the question of extending the electric light plant was discussed. The north side will be remembered next time. An independent plant for that section will be operated from the waterworks. Rush street, Chicago avenue, Clark, Wells and Division streets will enjoy the illumination. In the South side the plant will be extended on State street to Twenty-second, Wabash avenue to Eighteenth street, west on Twelfth street to Blue Island avenue, and northeast on that thoroughfare to Harrison street.

Concerning the electric light plant and Professor Barrett the Chicago *News* editorially says: "Chicago has a modest man in its employ who deserves a very merry Christmas. He is City-electrician Barrett, and to him this community owes a great deal. The new system of electric lights which shone in a number of the streets, last night for the first time was created by him. He it was who a year ago strung bouquets of

Prof. Elisha Gray's Laboratory at Highland Park.

Prof. Elisha Gray's laboratory is located at Highland Park, twenty-three miles north of Chicago. The building which is used as a laboratory, is a neat little cottage situated on one of the prettiest streets in the village. The situation of the laboratory is decidedly picturesque and romantic for so commonplace a structure as an electrical laboratory. It is built by the side of a deep ravine, which is covered in summer with wild flowers in endless variety.

No one would imagine that the structure was used as a workshop. Smoke is rarely seen issuing from the chimney, and seldom can steam be noticed escaping. The location of Prof. Gray's laboratory for these reasons is not well known even in Highland Park, and it is only necessary to make a trip to the village to learn the truth of the assertion. One feature of the cottage alone excites a suspicion and reveals the fact that it is not used for resident purposes, and that is the illumination by electric lights.

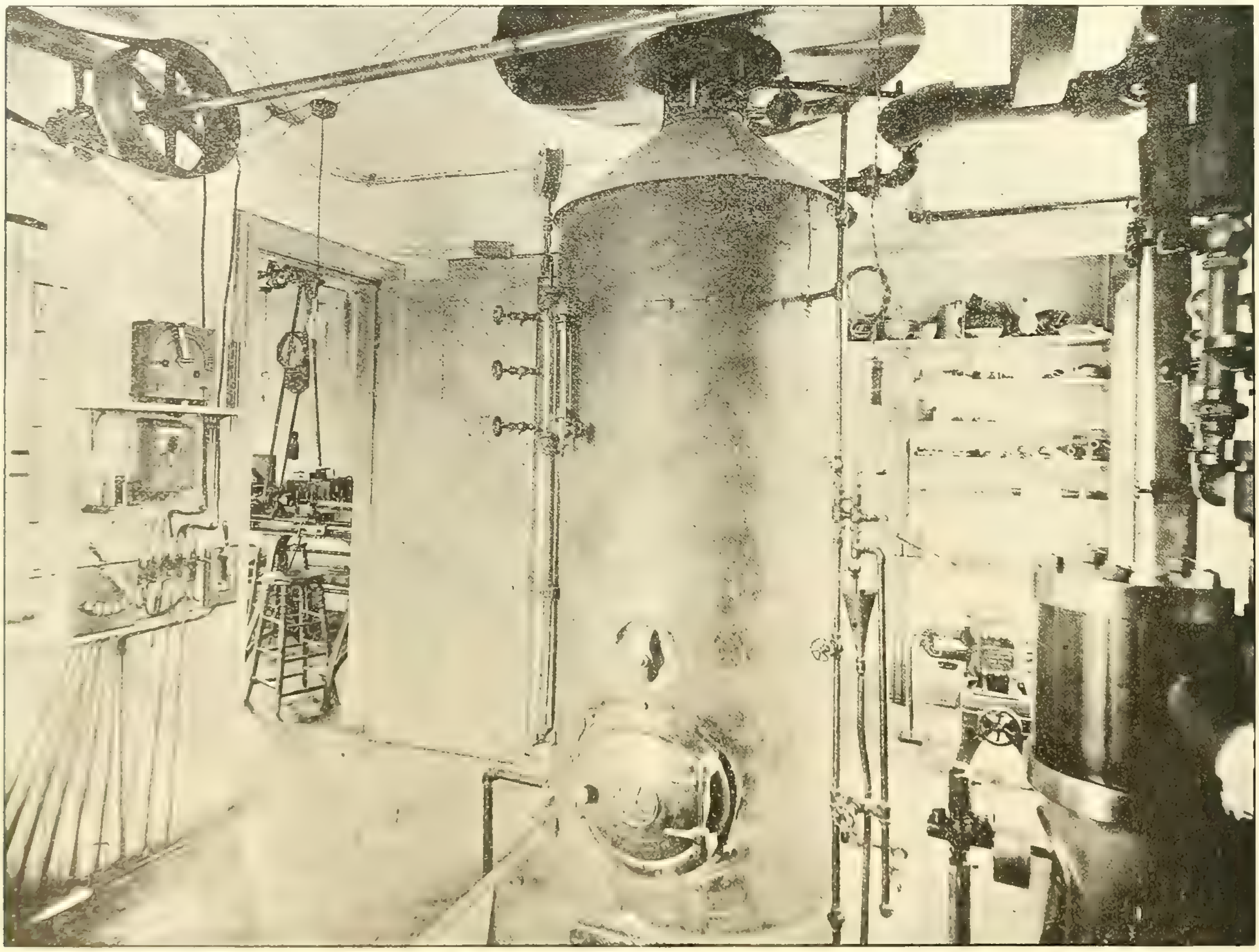


FIG. 1. PROF. ELISHA GRAY'S LABORATORY.—ENGINE AND DYNAMO ROOM.

[illegible] to introduce [illegible] his con- [illegible] city should [illegible] lighting system until [illegible] theory was [illegible] the only proper [illegible]. In this connection [illegible] objection that can [illegible] ground system is the [illegible] r, in a [illegible] light terri- [illegible] and has, [illegible]

electric lights along the river and by the bridges. He has put miles of hideous wires underground. He has perfected the police and fire alarm systems. In short, he has made himself immensely useful to this community. There is more work yet for Professor Barrett. We want him to light the entire city by means of his underground wires and his tall electric lamps. Then, perhaps, he can give us rapid transit by means of electricity, and after that a telephone system, which the city shall own. After he has accomplished these things no doubt something else will turn up which will give him other opportunities to [illegible]. We hope that Professor Barrett will [illegible] a century at least to harness lightning for [illegible]."

[illegible]

For a small laboratory, it is said that Prof Gray's is the most complete in the country. It is equipped with apparatus of every kind that can be employed in electrical experimenting. All the rooms are lighted by incandescent lamps of 16-candle power. Switches are so arranged that a person may illuminate a room on entering it and extinguish the light upon leaving it.

The accompanying views give an excellent idea of the three principal departments. Fig. 1 is a view of the engine room. The engine, which is of about 10 horse power capacity, is of the make of the New York Safety Steam company. The engine is used for running a line of shafting and for driving a [illegible]-light United States company's shunt-wound dynamo. A part of the current is employed directly in supplying the incandescent lamps, and the balance is used in charging the storage batteries. If in any way the engine should become disabled, the dynamo can be used as a motor, the accumulators furnishing the current. The machinery could be run in this way for eight hours. The cottage floor has been

thoroughly braced so that the vibrations from the engine are hardly perceptible.

The water for the boiler is obtained from the settling cistern in the ravine, which is just back of the laboratory. Water is pumped to a 150-barrel cistern by the side of the house. Thence it is pumped to a tank which holds twenty barrels, located in the upper part of the house. The tank is connected with hose, which can be utilized at once if a fire should break out. Lines of hose are placed in each room, so a stream of water could be turned on immediately.

The water from the cistern is used over and over again. The condenser is located in the basement. From the condenser the water runs back into the large cistern. The system is found to work to great advantage. The ravine water, when first used, causes considerable scale in the boiler, but, by utilizing the water again and again, it is possible to eliminate almost entirely this cause of trouble. It is found necessary

The testing room, Fig. 3, occupies the front room of the house, and it is supplied with all the apparatus which goes to complete a well-equipped experimental room. On an experimental table is a reflecting galvanometer. The table rests upon piers built of brick from the ground. Several of Prof. Gray's telautographs are there in the experimental state. The telautograph will be put into practical use probably within three months. Prof. Gray has received thousands of applications for instruments from all over the world. Instruments for the first installations will be made in Prof. Gray's laboratory in Highland Park, and a new factory is to be built for their manufacture. It has not yet been determined where the building will be erected, but it will be either in Chicago or in Highland Park. If the demand for the telautograph is as extensive as there is every reason to think, in all probability the second factory will be built at some point in the east.

[illegible] laboratory.

Coal Mining Machines Operated by Electricity.

There has probably been no greater [illegible] in the mining field effected during the past decade than the general introduction of [illegible]

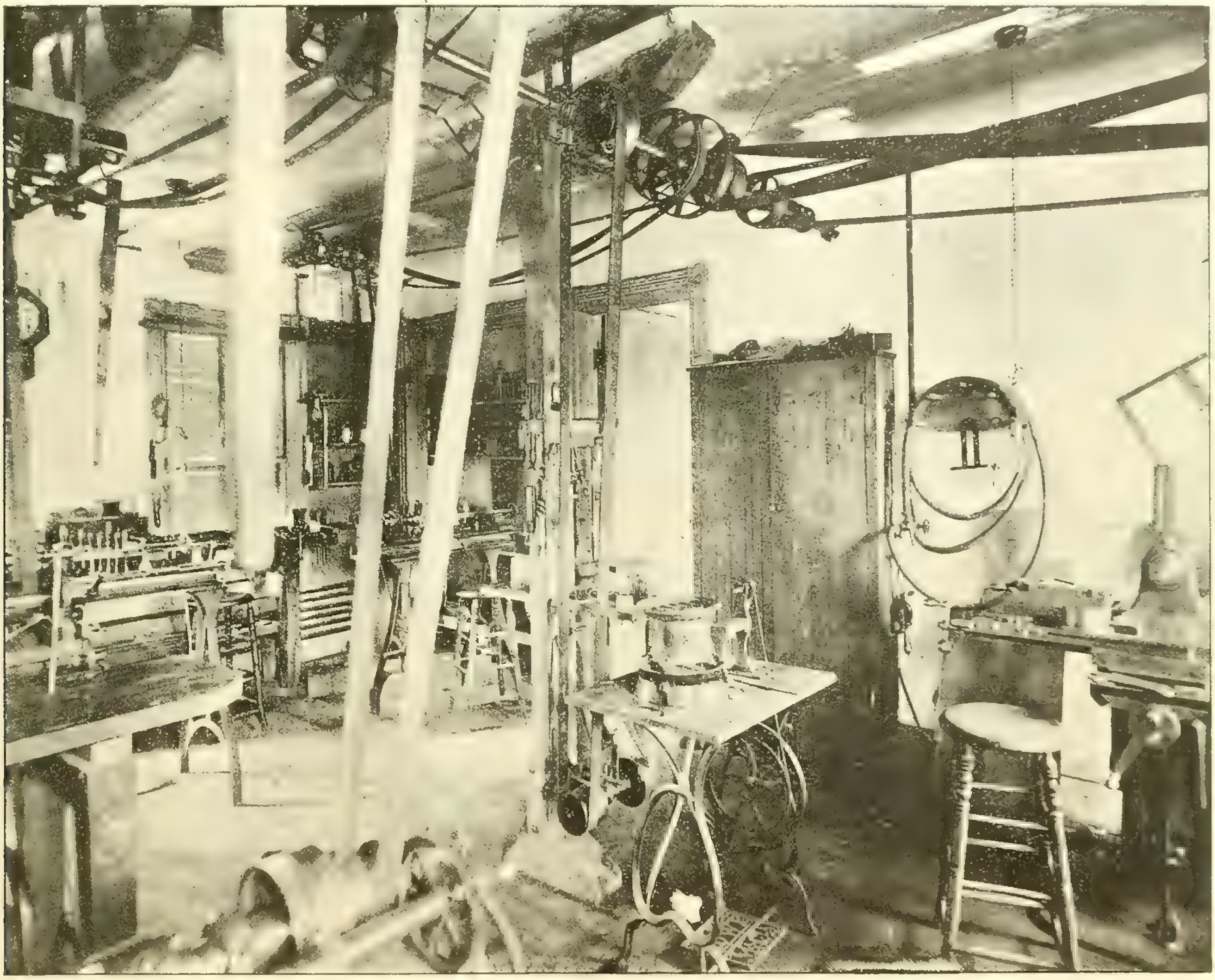


FIG. 2. PROF. ELISHA GRAY'S LABORATORY—WORK SHOP.

now to pump water from the ravine cistern only once a month.

Only hard coal is used—a fact which explains why the laboratory does not constitute a smoke nuisance in the pretty village.

The electrical apparatus for manipulating the current is complete in every detail. Fig. 1 gives a view of the switch, the voltmeter, ammeter and the indicator, which denotes the amount of water in the tank.

The blacksmith shop is in the rear of the engine room. It is supplied with forge, anvil and other apparatus. It is intended for light work mainly.

The workshop, Fig. 2, is located in an apartment of the house which was originally intended for the dining room. Six workmen are employed. They are now doing experimental work on the telautograph. The machinery consists of four screw cutting lathes, three for light work and one for heavy work, a Brown & Sharpe milling machine, winding lathe, drill press, and other light machinery.

The storage battery room is located in the basement, as shown in the cut in the WESTERN ELECTRICIAN of last week. There are thirty-one seventeen-plate cells of Detroit storage battery on the racks, and they do their work excellently. They are charged as it happens to be convenient. The engine completes the charging in about two days, doing the ordinary work in addition. As stated last week, a portion of the current is utilized in lighting Prof. Gray's house, which is near by. The cells are considered the reserve force of the laboratory, and, as already stated, can be called upon to furnish current for power if necessary. The Presbyterian church is quite near the laboratory, and it is proposed to light the building on Sunday evenings in the near future with current supplied by these cells. About thirty lights will illuminate the auditorium.

The second story of the house is used for storing. In the front room are 100 cells of Callaud battery, which are used for experimental purposes. The young man who guards the

for power and lighting purposes. The advantage of using electricity, its simplicity, compactness, safety, cleanliness and reliability over the use of steam for power, were early recognized by mining engineers, and electricity is now generally regarded as the most convenient agent at the miner's disposal for transmitting power into the interior of the mine.

One of the latest applications of electric power to mining work can be seen daily in operation at T. C. Heimes' Drane colliery, near Osceola, Clearfield county, Pa. Here a most interesting application of motors for mining work has been devised by F. M. Lechner for operating a coal cutter by electricity.

Mr. Lechner is well known, not only as the inventor of coal cutting machinery, but also as the first to operate compressed air in mines for this purpose. His long practice and experience in the coal-mining field have made him familiar with all the difficulties attending the use of machinery in mining work, and he has made a study of the problems in adapting electric power

to this work. It soon became evident to Mr. Lechner that the best results could only be obtained by operating the motor and cutter apart, as otherwise the size and weight of the cutter, with the motor mounted upon it, would prevent its easy transportation to the mine. In order to do this the following arrangement has been adopted in the mine, and has proved very successful:

The motor, which is a 10 horse power of the Sprague type, is mounted upon a truck running upon rails, so that it can be very easily handled and hauled from one position to another, as occasion requires. The entire weight of the motor is less than 1,000 pounds. The cutter operated by the motor, which in this case is the "New Lechner," is set in position in the room to be cleared, and is connected with the motor by a ⅝-inch rope belt, running in "V" shaped grooved sheaves, one being on the motor and the other on the cutter. This connection is long enough to allow the motor to be operated 30 feet from the cutter, and has been set in a position in this mine 1,600 feet away from the dynamo. The motor is held in position by guys at the point of use. By means of screw jacks that can be easily adjusted to any height with loose sheaves upon them, the cutter can be operated from any angle from the motor, and the connection is made taut by moving the truck upon which the motor rests, and securing it in

FIG. 3. PROF. ELISHA GRAY'S LABORATORY—TESTING ROOM.

the right position by guys. All mining engineers are familiar with the difficulty attending the working of the cutters in the limited space generally allotted them in mines, and realize how essential it is to have each machine divested [illegible] pound of surplus weight. They also [illegible] must be exercised in [illegible] crowbars to prevent [illegible] parts of the engines; [illegible] it is that con- [illegible] parts are so impaired [illegible] sent to the shop. The action of the engines shakes everything [illegible] they may [illegible] removed by [illegible] machine running [illegible]. By this plan [illegible] one motor, [illegible] room, where a machine is [illegible] again [illegible]

often as desired without any auxiliary aid. The efficiency of both dynamo and motor is over 90 per cent., so that, allowing 10 per cent. drop on the line, nearly 73 per cent. of the power delivered to the dynamo pulley can be depended upon at the motor for work. It has been estimated that the cost of equipping a mine for the purposes of operating machinery with electricity is only about one-half the cost of equipping with compressed air, and the price of maintenance shows about the same proportion of saving.

Proposed Installation at Marquette.

Fred. H. Whipple, who has been preparing plans for utilizing the water power of the Dead river for electrical purposes at Marquette, Mich., has about completed his labors and announces that his examination has proved entirely satisfactory. Of the course of the Dead river and the available power therefrom, Mr. Whipple says: "The Dead river is a tortuous stream running westerly of the city, having an elevation within six miles of 350 feet. Within this distance there are 14 falls, each from 10 to 50 feet in the jump. The Collinsville falls, embraced in the city's option, and at which the power station will be located, will give a fall of 54 feet, with an average horse power capacity the year around of 1,500. Should the demands of the city exceed this amount in the future, wheels may be put in another station 2,800 feet back from the first station, and the power brought to the first station by any of the various devices for transmission. My plans will embrace the thorough lighting of the streets with 100 arc lamps, and such private or commercial arc lamps as citizens contract for; also from one to two thousand incandescent lights for house lighting. The city will control the whole business. The present waterworks, which are on the direct pumping plan, will be run by electric motors, the current being brought to the city the same as for electric lighting. In addition there will be about 1,000 of miscellaneous horse power distributed among the manufacturing establishments in small motors. A street railroad is also contemplated, I believe, and if private parties secure the franchise the city will furnish the electric current. In fact, the entire question of electricity is solved in Marquette by the city owning and controlling it. The Collinsville falls are a little less than three miles from the center of the city. I shall be able to bring the current into town at a loss of from 2 per cent. to 10 per cent. This will be the first instance where waterworks pumps with their varying load will be run by electricity. I shall probably put in three motors, of 125 horse power capacity each. Marquette uses from 800,000 to 1,100,000 gallons of water per day."

Guard against Incandescent Lamp Breakage.

The following self-explanatory letter has been received:

LYNN, Mass., Dec. 17, 1888.

Editor WESTERN ELECTRICIAN:

We notice in your issue of Dec. 8, 1888, an article headed "Guard against Incandescent Lamp Breakage," in which the credit is given to Edward H. Johnson, of the Edison Electric Light company, of being the inventor of

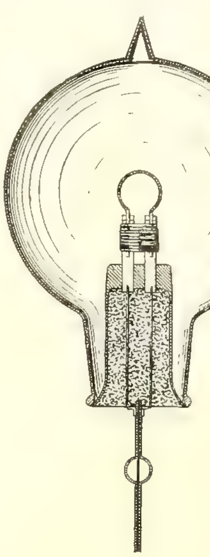


FIG. 1.

said guard device. Without desiring to diminish the value of Mr. Johnson's invention, we feel compelled, in justice to ourselves, to call your attention to patent No. 386,099, dated July 10, 1888, of which we inclose a copy. We also do not wish to "substitute the press for the courts for the purpose of legal interpretation;" still we venture to say that Mr. Johnson's device, as well as that of Mr. Holtzer—patent No. 356,199, Jan. 18, 1887—are subject to our patent mentioned above, claim 2 of which is: "An incandescent lamp having its entering conductors brought into proximity electrically, as described, and sufficiently near to be electrically united by fusion, through the influence of an electric arc formed between them on rupture of the incandescent conductor."

This quoted claim was adjudged to us after priority of invention had been duly established in interference proceeding in the patent office between Mr. Johnson and ourselves An account of the invention was also given in the November issue of the *Electrician* and *Electrical Engineer* for 1886.

Respectfully yours, HERMANN SEMP,
MERLE J. WIGHTMAN.

From the patent specification the following claims and the accompanying explanatory cuts are reproduced:

1. An incandescent lamp having conductors within its globe connected to opposite ends of the lamp and placed in proper proximity to be fused into electric contact with one another by an electric arc formed across the space between them on rupture of the incandescent conductor.

2. An incandescent lamp having its entering conductors brought into proximity electrically, as described, and sufficiently near to be electrically united by fusion through the influence of an electric arc forming between them on rupture of the incandescent conductor.

3. The combination, with the conductors within the lamp, of a wrapping of copper or other metal enveloping both conductors, and an insulating material applied in proper manner to prevent said wrapping from forming a circuit while the lamp is operating normally.

4. In an incandescent electric lamp, an entering conductor formed at the point of sealing from a thin metal

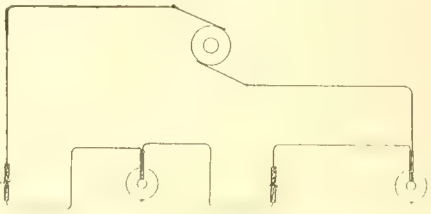


FIG. 2

plate and having the glass compressed against its flat or plane surfaces, as and for the purpose described.

5. The herein-described improvement in methods of constructing incandescing lamps, consisting in forming a sheet-metal blank with two legs or bifurcations separated from one another, sealing the said bifurcated portion of the blank, and dividing the blank longitudinally on a line passing between the two legs or bifurcations to make the separate insulated supports for attachment to the ends of the incandescing conductor.

Fig. 1 shows the lamp and the conductors within the globe, and Fig. 2 shows lamps connected in series with arc lamps.

Reckenzaun Storage Battery and Electric Tramcar.[1]

The design of storage batteries for the purpose of electric traction has occupied Mr. Reckenzaun's attention for a very considerable period, and he has conducted a long series of costly experiments in order to determine the most suitable and practical method of construction. A Reckenzaun plate in any stage of its formation may be bent to and fro, or doubled upon itself without any loss, or any trace of loss, of paste. Any one who knows how carefully plates of ordinary design have to be handled, and how fatal is any bending or deformation of the plate, will appreciate the significance of this feature in connection with a cell designed not only for rapid variations of output, but also to withstand the continual jolting and frequent handling which is inseparable from tramcar work.

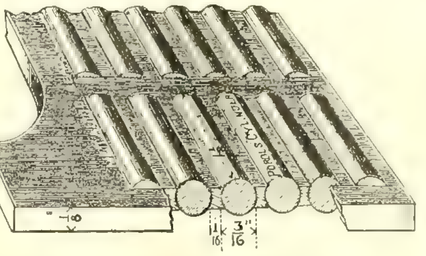
The expansion of the active material has been the cause of most of the trouble in storage cells, and this cannot be prevented; it is a necessary result of the oxidation of metals, and no amount of mechanical strength in the grids can stop it. In the early days it was thought that by making parts of the grids thicker, and by providing numerous insulating studs or separators between the plates, this tendency to rapid destruction could be prevented. But it was found that stout ribs only aggravate the evil, because when the active material expanded, it stretched the thinner ribs more than the thick ones, with the natural result of "buckling" the plate, and the least movement out of its normal line caused the paste to crack and tumble out in halves. M. Julien and others make use of alloys of lead and antimony which give a very stiff grid. This answers very well in cells where comparatively low current rates are used, but in thin plates for tramcars it was found that though the grid remained intact, the paste was bound to split and crack in the endeavor to find room for its own increasing volume.

Numerous attempts have been made to cast or roll grids, the holes of which were intended to offer concave sides for the better retention of the material, but these processes were attended with great difficulties and expense, and the results obtained do not seem to have come up to the expectations. During the early part of the year 1884, Mr. Reckenzaun struck out a new line of study with two objects in view, viz.:—Firstly, to ascertain whether it would be possible to produce compound plates without providing perforated supports, grids, corrugations, reticulated or other frames. For this purpose he tried various methods of casting pieces of oxide of lead together with lead, and he also tried to cast metallic lead round pellets of oxides. Having satisfied himself that this was possible, the next series of experiments were directed to discover whether and to what extent the shape of the oxide entered into the question of ultimate success, and it was found that not only the shape of the oxide, but also the shape of the supporting material influenced the final results of secondary battery plates. It is not difficult to understand that these experiments necessarily extended over a long period, and necessitated the most careful observations to note the relative effects of different arrangements. This process of evolution, however, had the effect of convincing Mr. Reckenzaun of the following facts:—First, cylinders of small diameter and comparatively great length are least liable to distortion, because they expand principally in the direction of their own axis, which is parallel to the surface of the plate; secondly, the minute expansion in the direction of their diameter merely causes more effective contact with the surrounding metal; thirdly, the metal which is cast round the cylinders must be of uniform thickness, and of soft, that is, pure, lead, so as to offer little resistance to elongation.

Some plates of this description which are said to have been in constant use for three years we have recently examined. We have bent these, rolled them up into the form of a cylinder, and unrolled them again without disturbing the active material, or observing any scaling of the plates. The construction is illustrated in the accompanying figure.

The porous cylinders are 3-16 inch in diameter, and about $1\frac{1}{16}$ inches long. After being formed in a mould they are put into cavities in a cast iron chill $\frac{1}{4}$ inch distant from center to center, and the molten lead is poured in, producing a substantial looking plate. The metallic part of the plate is only one-eighth inch thick, so that the cylinders protrude on both sides, and thus offer a large active surface to the electrolyte.

At the works of Messrs. Stephens, Smith and Co., at Millwall, there is now awaiting shipment an electric tramcar, fitted with these cells, and with the worm and wheel gearing with which Mr. Reckenzaun's name is connected. This car



RECKENZAUN STORAGE BATTERY PLATE.

is intended for the Sandhurst and Eaglehawk Tramway, in the city of Melbourne. The car itself is of the best American two-horse pattern. The body is so constructed that it can be taken apart for shipment. The machinery consists of two 8 horse-power Reckenzaun motors, each driving an axle through the medium of worm gearing. The motors are collectively capable of yielding 24 horse power, if required, without undue heating, and they will have to propel the car over gradients of 1 in 20 of considerable length. We have seen this car running, and starting on such a grade with perfect ease. The field-magnet coils of each motor are divided into four equal sections, and their ends are joined to a commutator at each platform. By turning this commutator these coils can be automatically coupled in a variety of ways; that is to say, the resistances of the motor circuit are varied by coupling the coils all in series, or all in parallel, or by either of the two other intermediate arrangements. Four different speeds and powers are thereby obtained, without interfering with the coupling of the cells. The motors are very compact, weighing 600 pounds, and meas- [illegible] worm, by means of a [illegible] [illegible] bearings [illegible] without in any way [illegible] driving gear.

The steel worms have [illegible] so that they can be driven [illegible] wheels; the car can therefore run down a slight grade [illegible]. The [illegible] wheels are of phosphor bronze, and run within a dust-tight cast-iron casing, and this [illegible] tains a quantity of oil, which lubricates [illegible] automatically without attention, for weeks. The top of the casing forms two thrust bearings [illegible] the worm to revolve in. We [illegible] that if at ordinary speeds this gearing will give an efficiency as high as 85 per cent., then its positive action, absolute silence, strength and compact shape render it particularly suitable for street car traction. The usual hand-brakes are used for stopping and going down grades.

The storage cells are 72 in number, each made up of 17 plates, giving a capacity of 160 ampere hours. The cells are placed on long boards under the seats. These boards are on rollers, and can be readily drawn out through doors at either end of the car.

[1]Abstract of article in London *Electrician*, December 14, 1888.

Power Transmission Plants Installed by the Oerlikon Works.

The employment of electrical energy for the transmission of power is more common on the other side of the Atlantic than statements frequently made might lead a person to infer. That manufacturers in Europe are making extensive use of electric motors is indicated by a reference to the accompanying table which contains data of interest concerning electric plants for the transmission of power, installed by the Maschinen Fabrik Oerlikon, Zürich. The plants in question were manufactured under the patents of C. E. L. Brown, electrician of the company, who sent the data to the WESTERN ELECTRICIAN. The figures therefore can be relied upon.

The progress which is being made in this department is emphasized when it is borne in mind that the table, showing a total of 1373 horse power, represents merely the installations of one company in Switzerland last year. In each of the installations the motive power for driving the generator was water. Switzerland and the northern part of Italy have, of course, remarkable facilities for applying water power for electric lighting and electric transmission of power. The tabulated figures should be of special interest to those interested in the development of the resources of the West. There are many localities in which water power could [illegible] be utilized. The large size of the electric machines is worthy of remark. In one case it will be noticed that a generator and motor are used for the transmission of 250 horse power.

Purchaser.	Horse Power Transmitted.	Number of Machines, Generators and Motors.	Generator Type.	Volts	Amperes	Revolutions	Conductors. Distance	Conductors. Diam in m. m.	Conductors. No. of wire	Electrical Energy Delivered.	Loss of Energy in Conductors	Cost in Francs. Generator	Cost in Francs. Motor	Cost in Francs. Conductor	Cost in Francs. Apparatus
M. Haiber, manufacturer of watches, Soleure	50	*4	2 poles, Series Dynamo.	2,400	15	700	8,000	[illegible]	3	75 per cent.	5.8 per cent.	[illegible]	[illegible]	[illegible]	[illegible]
R. & N. Frei, chocolate manufacturer, Aaran	16	2	2 poles, Series Dynamo.	300	36	[illegible]	[illegible]	[illegible]	2	[illegible] per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
G. Troller & Co., mill, Lucerne	120	2	2 poles, Series Dynamo.	1,000	80	450	3,000	[illegible]	2	[illegible] per cent.	12.[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
Bay & Co., cloth manufacturers, Steinbach	15	2	2 poles, Series Dynamo.	400	25	700	1,450	[illegible]	[illegible]	70 per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
Lange, linen manufacturer, Derendinger	280	*4	4 poles, Series Dynamo.	1,500	125	400	1,300	[illegible]	[illegible]	[illegible] per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
G. Rossi, factory, Provene, Italy	250	2	4 poles, Series Dynamo.	625	270	500	[illegible]	[illegible]	[illegible]	[illegible] per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
A. Wapfer, factory, Pordenone, Italy	70	2	2 poles, Series Dynamo.	600	50	600	1,000	[illegible]	2	[illegible] per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
C. T. Bally, shoe manufacturer, Schonewerd	12	2	2 poles, Shunt Dynamo.	200	35	900	500	7.0	[illegible]	70 per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
G. & N. Legler, factory, Diessbach	120	2	2 poles, Series Dynamo.	1,000	80	550	600	8.0	2	[illegible] per cent.	2 per cent.	[illegible]	[illegible]	[illegible]	[illegible]
Contonificio della Vallo Seriana, Garzaniza, Italy	100	2	2 poles, Series Dynamo.	1,000	67	600	[illegible]	7.0	2	[illegible] per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
T. Rausch, mill, Innisbruck, Austria	50	2	2 poles, Shunt Dynamo.	1,100	30	700	450	5.0	2	[illegible] per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]
Prochoroff, weavery, Moscow, Russia.	70	*4	2 poles, Series Dynamo.	1,500	30	600	[illegible]	[illegible]	[illegible]	[illegible] per cent.	8.0 per cent.	[illegible]	[illegible]	[illegible]	[illegible]
F. Papiers, Steyermuhl, Austria	100	2	2 poles, Series Dynamo.	1,000	67	600	600	5.0	[illegible]	[illegible] per cent.	2.4 per cent.	[illegible]	[illegible]	[illegible]	[illegible]
Contonificio della Vallo Seriana, second order	120	2	2 poles, Series Dynamo.	1,200	67	500	800	8.0	2	[illegible] per cent.	[illegible] per cent.	[illegible]	[illegible]	[illegible]	[illegible]

* Three wire System

POWER TRANSMISSION PLANTS INSTALLED BY THE OERLIKON WORKS.

Western Electrician.

EVERY SATURDAY.

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W. A. KREIDLER,	Editor and Publisher
J. W. DICKERSON, - -	Associate Editor
[illegible]	[illegible]
[illegible]	Business Manager

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WITH this number we begin a new volume and a new year. The standing and reputation of the WESTERN ELECTRICIAN are now so well established that promises for the new year would be superfluous. This standing and reputation will be enhanced during 1889, however, and it will be interesting in the future, as it has been in the past, to watch the steady, forward progress of a scientific and trade journal conducted upon correct principles.

THE storm of last week was particularly severe in the vicinity of Kansas City, Mo., and a correspondent sends an interesting letter, in which he describes the damage sustained by the telephone, telegraph and electric light companies. [illegible] of the fire [illegible] the storm that [illegible] Kansas City have [illegible] seem to have [illegible] the reports of [illegible] are not [illegible]

[illegible]

for both prophecy and fulfilment, we commend this intelligence as an argument, strong from their standpoint, not from ours. We need no stronger argument than that which led us in the first instance. We need no greater incentive than the constant words of approval we receive, to hold us to our belief that the welfare of the gas companies is best served by the union in their hands of all the lighting interests."

AN illustrated article descriptive of Prof. Elisha Gray's laboratory at Highland Park appears in another column. For a small structure it is said to be the most complete in the United States. When the telautograph is fairly put upon the market, Prof. Gray expects to build a more pretentious laboratory. The telautograph is to be put into commercial use in the spring. Applications for instruments have been received from all quarters of the globe, and numberless inquiries manifesting the liveliest interest in the invention, have been sent to Prof. Gray.

AN exhaustive paper by W. J. Jenks, in which he details his practical experience with the Edison meter, appears in this issue. He treats of its development, and lays stress on two characteristics, which he says belong to the invention—cheapness and accuracy. The discussion by the members of the American Institute of Electrical Engineers is full of interest. The gas companies owe a debt of gratitude to several gentlemen who participated in that discussion. They championed the cause of the much-maligned gas meter, and testified to its general accuracy. Such testimony, coming from competitors, must be invaluable to representatives of the gas interests.

THE daily press, as a whole, has taken a decided stand against that clause of the law providing for the substitution of electricity for the halter in New York state, which forbids the publication of descriptions of executions. District Attorney Fellows of New York city holds that the provision is unconstitutional. He says: "Among those whom the sheriff has a right under the law to invite to witness the execution, there is no reason why newspaper reporters may not be invited. In fact, they probably will be present. If they were not invited what is there to prevent myself or any one else present to recite the facts in conversation after the execution is over? To forbid that I should recite the facts would be to forbid free speech. And furthermore, what does a reporter do but recite the facts to half a million readers instead of to a group of friends? Of course, if an indictment should be found against an editor or reporter for printing and reporting the execution I should be compelled to prosecute, but in my opinion the judge would hold the law to be unconstitutional, or at any rate the trial would not result in a conviction."

THE new Chicago electric light system illuminated the city for the first time Christmas eve. The citizens expect that in due time all the thoroughfares will be lighted by electricity, and the new plant represents the first step toward that end. The plant is by no means a small one, and in addition it may be said that it is the largest city underground system in the world. City Electrician Barrett, who has labored early and late upon the undertaking, and to whom is due in a large measure the success of the project, anticipates that the taxpayers and citizens will soon realize the superiority of the new system, and that its successful operation [illegible] a rapid extension of the territory [illegible] by electricity. It is generally agreed [illegible] the introduction of electricity as [illegible] was a wise measure, [illegible] system is extended to [illegible] the better. Chicago has [illegible] respect, but now [illegible] an admirable beginning [illegible] anticipate that before [illegible] energy, it will force [illegible] lighted by [illegible] important feature [illegible] connection. The old system of illumination by gas and oil is much more costly, Prof. Barrett says, than that of utilizing electricity for public lighting—in fact he asserts that the saving to the city will pay the expenses of replacing the gas lamps with electric lights.

A cut showing a view of the dynamo room and a description of the new system will be found in another place in this issue.

The decision in the St. Louis telephone case does not seem to disturb the confidence of the agitators representing the Druggists' association of Chicago, who are seeking to prevail upon the city council to pass an ordinance to regulate telephone rates, in the face of an adverse decision, and an opinion from Corporation Counsel Green declaring such action invalid. At a recent meeting of the association a report was presented in which the council was urged to pass an ordinance in conformity to the views of the subscribers, and similar resolutions were subsequently adopted.

At a meeting of the executive committee of the Telephone Subscribers' league the ordinance now pending before the council was condemned, and a committee of five was appointed to draft a bill for presentation to the legislature regulating the maximum charges of telephone companies within the state. The meeting stipulated, however, before appointing the committee, that, in its opinion, the council already had sufficient power, but it was desired to fortify the position at all points in case the council should fail to exercise its present power.

FROM time to time reports are made that Mr. Edison is working on an invention by which he hopes to convert coal into electrical energy without resorting to any intermediate process. Mr. Edison, in several interviews, has expressed his confidence in his ability ultimately to solve the problem. The Chicago *Tribune*, in commenting on the last report on this subject, says: "If he is able to convert into electric energy the power that lies in the carbon and hydrogen of coal he will have given to man the greatest gift that man can ask of nature, unless it be the control of the winds and rains. He will have multiplied by ten the present capacity for work of every ton of coal in the world. He will have revolutionized the world of machinery. What the Corliss engine is to the primitive water wheel of the Egyptian of the days of Pharaoh that will Edison's device be to the present steam engine. Steam engines and gas engines will all go to the junk-shops, and new plants—what we cannot yet tell—will take their place. Should Edison make such a discovery, all we ask of him is that he will be moderate, and that he will not charge so high a royalty as to heap up for himself a fortune of more than a thousand million dollars during the life of the patent."

WITH the extension of underground systems in cities come the reports of explosions in conduits. There is a substantial agreement as to the cause of these accidents. Gas leaks from defective mains, and collects in the conduits. In some mysterious way which no one seems to be able to explain, a spark causes the confined gases to explode. There appears to be no doubt that leaking mains are all but universal. A gentleman interested in the construction of the subways in New York said, after the recent explosion in that city, that such occasional explosions would continue to happen as long as gas corporations ran leaking pipes below the street. "At present, gas companies," he said, "think they do well if they keep their leakage down to 15 per cent., and this 15 per cent. goes to permeate our earth with the material for such explosions."

The Rochester *Morning Herald*, in commenting on the defective mains, says: "That seems to be the nature of gas mains in all cities. Here in Rochester, whenever excavation is made in a street, the most offensive odor pours out, the result of the soil being saturated with illuminating gas. There ought to be help for much of this in the new method of putting pipe as large at least as ten inches, together with screw joints."

American Institute of Electrical Engineers.

A meeting of the American Institute of Electrical Engineers was held in New York, December [illegible] M. Phelps was chosen chairman. W. [illegible] of the Edison standardizing bureau, read a paper on "Six Years' Practical Experience with the Edison Chemical Meter." The paper was as follows:

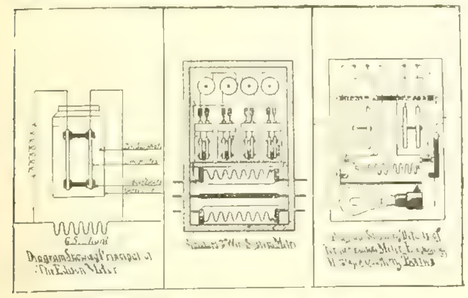


FIG. 1. [illegible] OF METERS.

SIX YEARS' PRACTICAL EXPERIENCE WITH THE EDISON CHEMICAL METER.

"Measure for measure" has ever been the underlying principle of the trade of the world. The mess of pottage for which Esau bartered his birthright was as truly in his eyes a recompense for the distinction and the patrimony with which he parted, as the property and the necessaries of life which we acquire are in our view an equivalent for the gold and silver which we pass from hand to hand in everyday exchange.

If we start out in life with the notion, so fondly cherished some time or other by every human heart, of getting something for nothing, we shall speedily realize the truth of what somebody has happily expressed in verse:

> The motto of the world is "give and take,"
> It gives you favors, out of sheer good will,
> But unless speedily you compense you make,
> You'll find you'rs it presents, with its bill.

We are not in business matters long contented with any system of guesswork as to what the amount of this bill

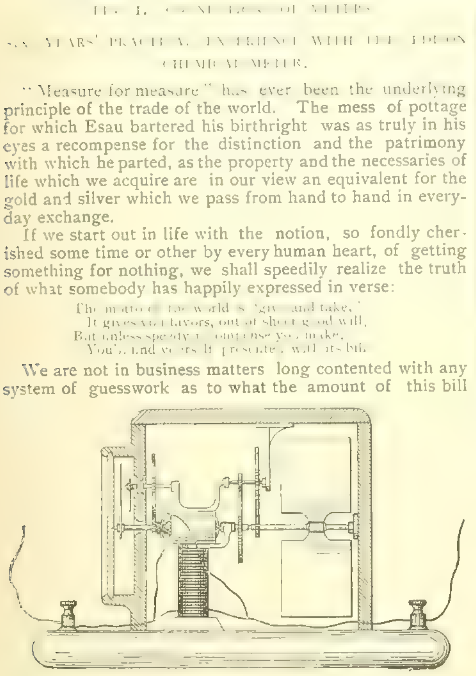


FIG. 2.

ought to be. Where values cannot be measured, we demand averages based upon long experience. Where it is possible to measure goods delivered, the ingenuity of man is untiring until some means is found adapted to the uses of all the traders of the world. It is only so far as we can draw from nature's limitless supply of necessaries and blessings "without money and without price," that we fail to find in these days a meter check upon our consumption. As long as people live in civilized communities, water and artificial light will represent somebody's labor, and as they come to be more and more generally used, they must be more and more accurately measured.

Perhaps it has never occurred to many of us that about all the system of measurement that has ever quite satisfied mankind is the method or device by which we reckon the

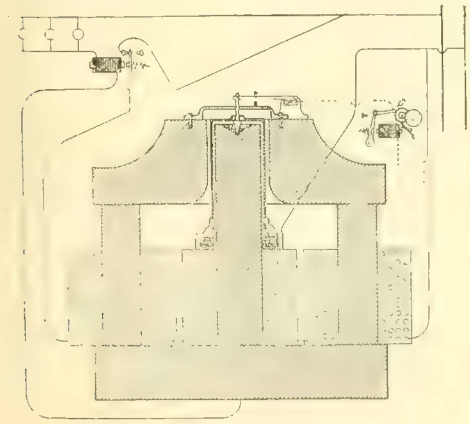


FIG. 3.

passage of time, which doesn't cost anything. We look with suspicion on the scales of the butcher, and we don't believe the milkman's quart is more than two-thirds as large as it was years ago, though the price has advanced several per cent. When we buy dry goods we speculate on whether it isn't best to redetermine the length of a pendulum that will beat seconds at the level of the sea, or establish a new yard on the metric basis, after we measure the distance from the equator to the poles again. We know [illegible] the water meter [illegible] and often [illegible] meter [illegible] reads it as being [illegible]

Now the [illegible] current meter [illegible] by the [illegible] kind as a [illegible] of the gas meter [illegible] the old [illegible] Unfortunately we [illegible] the light or power [illegible] from the [illegible] approximation [illegible] record [illegible] of the quantity of energy supplied, is our only practical alternative. The method which we shall examine to-night, is thus far the only commercially successful means of measuring the energy delivered to electric lamps or motors. It [illegible] first-born of a [illegible] will share in the stigma which the tribe of meters of all kinds have [illegible]

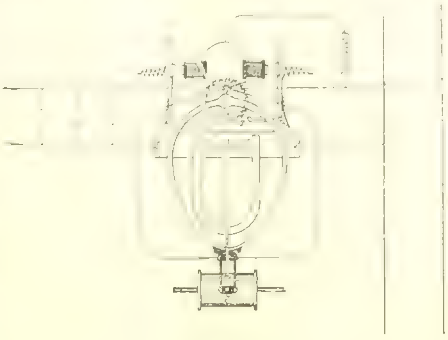


FIG. 4.

in this case is undeserved, and how much more accurately we can measure the mysterious intangible something, which we only know is a manifestation of energy, and which we call electricity, than we can the palpable forms of matter which are apparent to all the senses, is the purpose of this paper.

In the approximation which we make to the measurement of the light, heat or power secured from gas, we have three variables: Quality of gas, rate of flow, and form of burner or method of consumption. In electrical work we eliminate at once the first and one of the most uncertain of these variable factors, for there is no difference, so far as we can discover, in the quality or commercial value of electrical energy from different sources, unless we change the method or the rate of its delivery, as for instance, send it out in intermittent or alternating impulses.

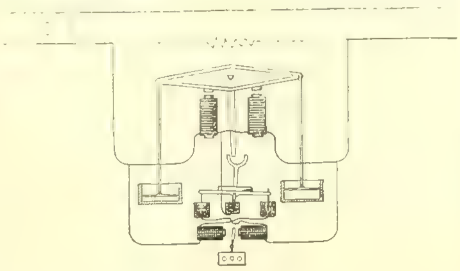


FIG. 5.

So in order to arrive at a price at which we may profitably sell light or power, we must know the electrical horse power demanded by the translating device for a given result, that is the efficiency of the lamp or motor and the energy actually delivered during the time of consumption. The work done or heat generated, which bears a definite relation—in a given type of lamp or motor—to the light or power produced, is expressed in three factors—pressure, current flow, and time, and the product of these joules or units of work accomplished in a given period, is what we desire to measure. In the Edison system the light of the lamp and the speed of the motor are based upon the supply at their terminals of a constant pressure, and as the Edison meter is in its relation to the resistance of the cir-

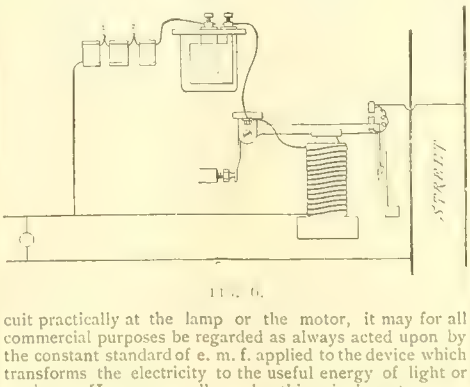


FIG. 6.

cuit practically at the lamp or the motor, it may for all commercial purposes be regarded as always acted upon by the constant standard of e. m. f. applied to the device which transforms the electricity to the useful energy of light or motion. Hence we really make this a joule meter, even while we drop the pressure which is a constant, and make it a measurer of current and time, or a coulomb meter. Its construction is based upon the fact that a given ampere flow will deposit a given weight of metal per second, and so knowing the weight of zinc deposited on a plate, it is easy to calculate the number of ampere-seconds. In practice we take the hourly deposit 1224 milligrammes of zinc by one ampere, and knowing the fraction of an ampere

[illegible] etimes the pr[illegible] supplie[illegible]

trollable, that the necessity for such a m[illegible] vital.

The records of the patent offices [illegible] method of connecting lamps, motors or similar translating devices in multiple arc, the only commercial method [illegible] taining this individual current control of current actuated by [illegible] Mr. Edison. Beyond this there is no question that we owe to him the first comprehensive conception of that form of multiple arc distribution which by combining a low resistance armature, a feeder system of transmission, and a high resistance [illegible] and motor, has made it possible for us to secure a [illegible] lamps and motors a marvelously close approximation to

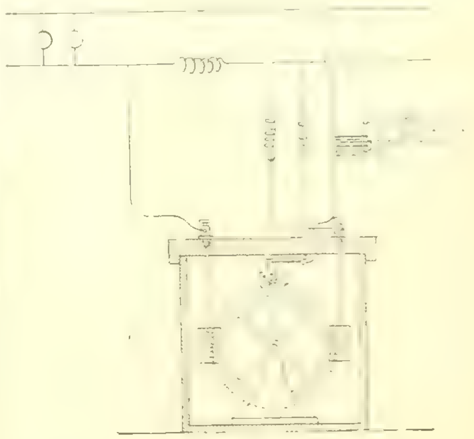
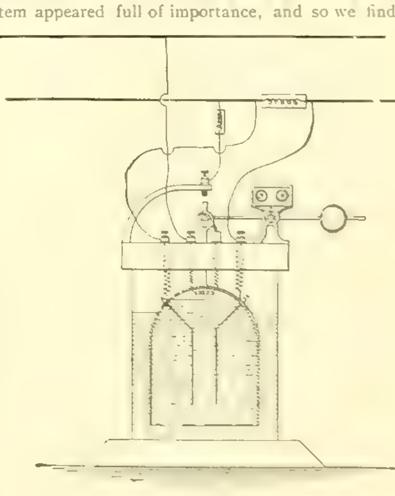


FIG. 8.

uniformity of pressure, and the expenditure of the largest economical percentage of the initial pressure in overcoming the resistance of the carbon filament, or the motor armature, and thereby producing the greatest amount of useful work.

To Mr. Edison's view each detail of such a complete system appeared full of importance, and so we find him,



almost before he had a commercial lamp, [illegible] meter by which each customer's consumption [illegible] curately determined, and which could be placed on the premises and inspected at such intervals as experience [illegible] shown was reasonable in the supply of the [illegible] able quantities, gas and water. He [illegible] not only be accurate, but cheap and durable. [illegible] of the subject he applied several principles [illegible] registration, tried a great number of experiments [illegible]

and secured several patents. Among them are the following:

Fundamental electric motor meter.—Patent 242,901. [illegible] Fig. 2 shows a noble example of a large class of meter inventions in which some kind of an electric motor driven either by part or all of the current to be measured, is employed to overcome a fluid [illegible] by the combination of a circuit, motor, fan, or other definite loading and registering apparatus.

Fig. 3 shows another form of electric motor meter. No. 70,123. Patent applied for April 17th, 1883. The form of motor used is a development of "Sturgeon's wheel," the wheel being transformed into a cylinder surrounding one pole of the magnet, itself being surrounded by the other pole. In this meter the indefinite friction is reduced to a very small factor, brushes are replaced by mercury contacts and a very compact and simple form is possible. Probably if mercury did not have such a chronic disability to behave itself in practical continuous work, and if it really possessed the ideal character of a liquid which it commonly gets credit for, we would have seen this meter

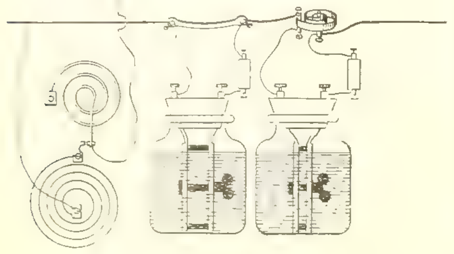


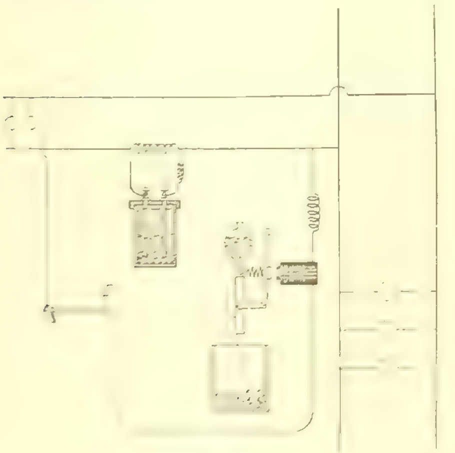
FIG. 10

put into practical use by some of the many inventors who have given it attention. This patent covers, among other things, the placing of the inductive portion in the direct circuit and the fields in multiple arc therewith. A magnet in the main circuit closes the field circuit whenever the first lamp is attached, thus stopping the motor whenever the current flow is arrested.

Galvanometer recorder.—Patent 307,030. Application filed Oct. 10, 1883. This covers broadly a multiple arc circuit, a galvanometer in the main line, a circuit controlled by the needle, electrically operated apparatus in this circuit, and indicating or registering devices. Preference is given to a stylus recorder, the diagram made to be measured by a planimeter. Fig. 4

Recording electro-mechanical meter.—No. 293,435. Applied for August 14th, 1882. Fig 5 shows a pivoted beam oscillated by electro magnetic coils in the main or a shunt circuit, the rapidity of motion (regulated by air dashpots of large surface) being practically proportional to the strength of the current. The recording mechanism actuated by a local circuit operated by mercury contacts.

Fundamental electrolytic meter patent.—No. 251,545. Application filed March 20th, 1880. Fig. 6 shows the electrolytic meter according to the first Edison patent. An electro-magnetic cut-out is shown and claimed as part of the meter. The principal claim covers the use of an electrolytic cell placed in a shunt circuit, the resistances being so proportioned that a definite fraction of the current passes through the cell.



[illegible]

transfer of copper from plate to plate from going always in one direction; i is a simple electrolytic cell used as a check. This is probably significant of the inventor's lack of faith in mechanical meters, and is particularly interesting to look back upon, in the light of subsequent progress.

Revolving recording electrolytic meter.—(Still pending in the patent office.) Fig. 8 shows an interesting modification of an integrating electrolytic meter, in which between two electrodes immersed in the electrolyte is placed a wheel or cylinder of the same metal, free to revolve on its axis. It is apparent that if the wheel were perfectly balanced and delicately poised, the passage of a current

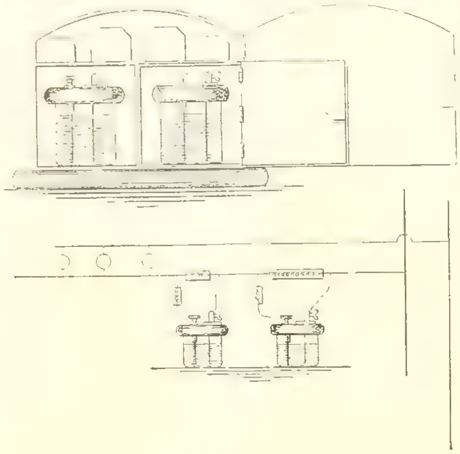


FIG. 12.

would alter the balance, and it would revolve at a speed depending almost entirely on the friction of its bearings. But if it were first caused to revolve at a definite rate for one-half a revolution, the lower limb moving in the same direction as the current, there would be a deposit and loss on opposite halves of the disc, causing a variation of position of the center of gravity around the point of support, causing the revolution to continue at the same rate for the same current, or at a rate proportional to the current.

The diagram shows a dial scale for reading fractions of a turn and an electric counter recording complete revolutions.

Floating electrolytic cell.—Patent 248,565. Application filed Dec. 15, 1880. Fig. 9 shows an endiometer intended to decompose water, collect the mixed gases in a bell-glass, and when a definite quantity is evolved by the raising of the glass automatically cause recomposition (and

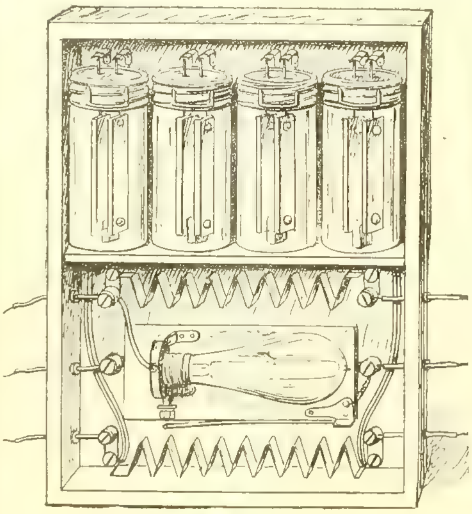


FIG. 13.

consequent falling of the glass) by closing a circuit through a platinum coil which becomes heated thereby. This operation is to be repeated continuously while the current is passing, a counter giving a record of the number of charges of gas exploded.

Among the difficulties of using such an apparatus are the comparatively high e. m. f. required, the energy wasted, and possibly like the nitro-glycerine engine, "the necessity of procuring a new machine after each explosion." A very [illegible] apparatus has been recently proposed as a laboratory [illegible]

[illegible] temperature regulator.—No. 251,55?. Filed [illegible] The patent, illustrated in Fig. 10 [illegible] of the Edison meter of to-day [illegible] the resistance [illegible] of the liquid in the bottles [illegible] through L at the proper [illegible] for holding [illegible]

[illegible] regulation patent.—No. [illegible] Fig. 11 illustrates [illegible] a thermostat [illegible] a valve, which [illegible] This [illegible] of the "card" [illegible] agencies for [illegible] maintaining automatic tempera- [illegible] Another method [illegible] practiced the [illegible]

circuit to an electric lamp placed in proximity to the cell." On the same date of this application Mr. Edison filed Patent No. 281,352, describing one of the most vital features of the practical apparatus, namely, amalgamated zinc electrodes in a solution of sulphate of zinc. This overcame the disadvantages of copper plates, which had formerly discouraged the inventor.

Compensating coils in electrolytic meters.—No. 25[illegible] Applied for May 27, 1881. Fig. 12 illustrates certain minor claims of details, some of which apply to the Edison meter of to-day, and one feature without which probably no electrolytic meter would be practical, the "compensating spool" having a + temperature coefficient to balance the — coefficient of the bottle resistance. This also covers the use of two cells, depositing with unequal rapidity.

The original plan involves, of course, only a two-wire meter. This was first made with separate resistance for each bottle, one of them being intended to register a month's consumption, the other three months. It was also proposed that the two compartments have separate keys, the inspector of the three month's bottle thus having a private check on the three readings taken in the same

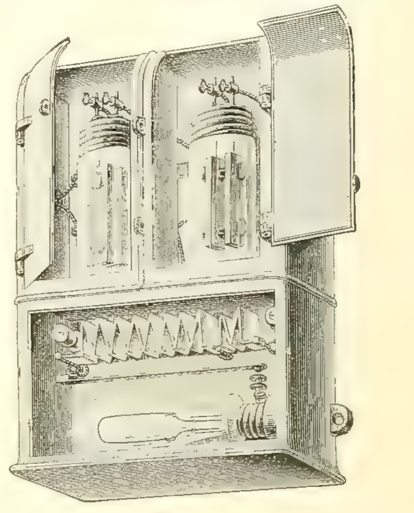


FIG. 14.

time from the other side. It was soon found preferable to weigh both sets of plates together, particularly as inexperience in the manipulation gave rise to errors against which the duplicate records formed a check of great usefulness. This duplication has been found unnecessary in the smaller sizes.

The student of the meter question may find interesting modifications of these general principles in patents 240,678, 281,352 and others.

These sketches and the patents enumerated, convey a faint idea of the months of patient analysis, the multitude of experiments and the scores of models and drawings which may be found described in Mr. Edison's notebooks, many a page written by his own hand, years before the electrical fraternity conceived of the importance of these devices for which the world now loudly calls. The elec-

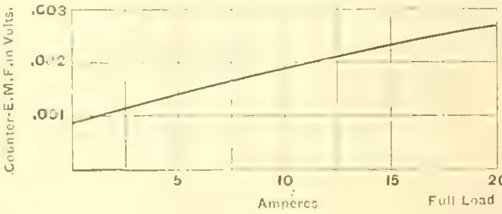


FIG. 15.

trolytic principle was finally determined upon, the details perfected, and more than six years ago the first devices were placed in the offices and stores of the first customers of the Pearl street Station in this city, the first station in the world to distribute current for incandescent lamps by a comprehensive system of conductors buried underground like gas pipes. The experiments thus made were so exhaustive and thorough in their character, that the meter then designed is substantially the one in use to-day in common stations throughout the United States and several stations in foreign countries. The Edison company has tested every form of direct current meter thus far found in any degree practicable without discussing (as vital) the question of economy either in first cost or operation, and has no knowledge of any other form which has been found to be as accurate under all working conditions, and as reliable when submitted to that tribunal before which so many carefully constructed electrical devices fail, the test of time. The Edison meter is also cheap, but this

of less vital importance. Hence all other forms appear to be commercially impracticable. Some have [illegible] fects, caused by variations of permanent magnetism. Some are too large to [illegible] value for [illegible] and they are almost without exception too costly and delicate for practical service, or too wasteful of the energy they demand for their operation. We have abundant evidence of the justice of these statements when we remember that out of the large number thus proposed, there is not another which has come into anything like extended use.

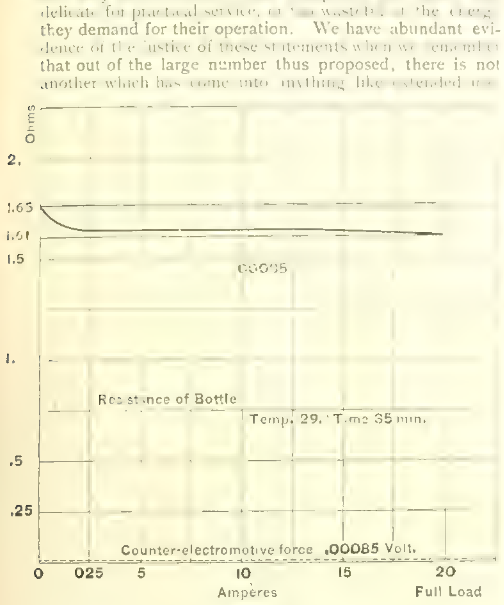


FIG. 16.

The record which we can quote is therefore the only one from which any conclusions can be drawn as to future practice in this direction

We shall be better prepared to appreciate the results obtained after glancing at the distinctive features of the meter as at present constructed.

Each consumer has a meter upon his own premises, and his bill is made out and payment required upon what the meter shows. To measure the current by means of a meter, and to do so with sufficient exactness to support a bill, the payment of which was to be insisted upon, at first seemed to many of the customers of our various companies an impossibility, and they accordingly resorted to various devices for the purpose of themselves testing the accuracy of the measurements. The most noteworthy of these, for the reason that it affords a simple and effective check, was to keep a record of the hours each lamp was in use, and by multiplying this number by the given rate of a sixteen-candle lamp per hour, determine what the amount of the bill ought to be. There have been many instances where, in order to satisfy customers that the meters were reliable, we have taken their record at the end of a given time, during which the customer has kept an account of his lamp hours, and have presented bills upon what the meters showed, that the customer might check the amount of his bill by this simple rule.

Some months ago a very careful test, covering five

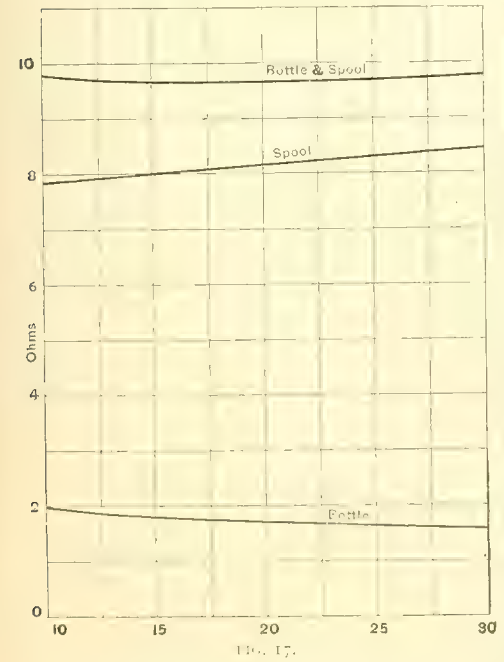


FIG. 17.

months, was made by the engineering department. Six Edison meters were connected in series with the meter of the Edison Electric Illuminating Company from the station by which the current is supplied to the offices occupied by the parent company. At the close of this test it was found that all of these meters registered within 1½ per cent. of each other.

An elaborate test was conducted at New Brunswick, N. J., by W. S. Howell, with seven meters put in series with ten lamps. The readings showed a variation of only one and one-half cents in the amount of the bill charged, while four of them were alike to a cent. The advantage of such [illegible] not only to the [illegible] but must also be satisfactory to the most exacting cu[illegible] [illegible] experienced [illegible] [illegible] [illegible] [illegible] pelled to.

At [illegible] meeting of the association of [illegible] companies there has been a full and impartial di[illegible] the relative merits of the two methods. The result [illegible] be briefly and forcibly summed up in the following, unanimously passed at the meeting of the Association held at Chicago, Illinois February 9th, 1888:

"[illegible] after a full discussion of the [illegible] merits of the meter and contract systems in the numerous meetings of this association, that it is the sense of the association that the Edison meter is accurate, that the system is not too expensive for stations above [illegible] and that the best financial results are invariably secured in a station selling by meter."

Fig. 13 shows the iron case of the form of meter [illegible] at the time of starting the first District Station, September 4, 1882. The division in the g. s. shunt resistance for the long and short period bottles has given place to a method of connecting both to the same terminals. The flexible connections have been superseded by the spring clips, and in the three-wire meters two shunt resistances are placed as in Fig. 14.

Stripped of all complications, the connections of these types are clearly shown in the annexed diagram:

Mr. Jenks said the true criterion by which to judge of the meter was the success it had met with in practical use. To ascertain the facts a circular had been addressed to the managers of twenty six stations now employing the Edison meter and asking their opinion as to its merits. They approved of it as an accurate instrument and one which was almost indispensable. Mr. Jenks continued as follows:

FIG. 18.

It has been argued that the Edison chemical meter, in its best estate, is open to several very serious objections:

1. The necessity of the expense attending the removal and replacement of the bottles, usually at monthly intervals, and the complete disconnecting and weighing of their plates. So far from being a detriment, this is seen to be in the light of practice a positive advantage. A gas meter is adjusted once for all, and once placed is inspected only at long intervals, or when strongly suspected of inaccuracy, while the Edison meter receives thorough inspection and radical readjustment every month. The sources of error lie almost entirely within the bottle, and are thus speedily corrected.

2 The necessity of employing what objectors are pleased to term a "chemist" as a meter man. In the early history of any art, until the conditions of practice become thumb rules, the manipulator of an important device should be a man of intelligence and some originality of ideas. After a time the work becomes simply a matter of routine, and the occasional oversight of the manager or other official will detect any irregularities. Thus it has been with this branch of our work. The most of our meter men are young, and receive only moderate pay, as the statement of cost of operation elsewhere given, conclusively shows. Accuracy and caretaking in matters of detail are the prime requirements. The work has been greatly simplified by arrangements with Mr. Edison, by which electrolytic zinc plates, standard zinc sulphate solution in carboys (or salt, if preferred), distilled mercury and four simple reagents, for the testing of water for solution by such companies as prefer to prepare it themselves, as a matter of convenience or economy. These reagents are (1) Ammonia water, (2) Ammonia sulphide, (3) Nitrate of silver and (4) sulphocyanide of potash, a few drops or a small crystal of each, as the case may be, to be added to separate portions of water. Any meter man can thus make the four simple tests, which, by a precipitate or by cloudy coloration, will show the water to be unfit for use.

Ordinarily, ice water is available, and when this fails, a simple apparatus for condensing and distilling, costing $25, is sometimes desirable.

Sources of Error. This brings us to the consideration of the real importance of the sources of error. Nothing that [illegible]

[illegible] the heating of the current.

[illegible] the change due to a rise of current in the met[illegible] trated, from 0 to full load or 20 amperes [illegible]

It is also clear that the error due to the rise in tem[illegible] one of the factors in the temperature resistance curve [illegible] crease of absolute resistance and consequent r[illegible] each other, forming a beautiful compensation, which [illegible]

[illegible] bottle resistance by itself, the fall in counter e. m. f., and consequent rise in volts, with a rise in temperature, adds slightly to the rise in volts attending the fall in resistance. These two factors are together opposed by the influence of the spool, whose copper wire increases so as to make a perfect [illegible] the curve at intermediate points.

Rate of deposit and current, Fig. 18. This curv[illegible] result of the combination of the sources of error sho[illegible] the others in detail, is so close an approximation to a [illegible] load. Into the depth and sharpness of this bend t[illegible] runs almost absolutely straight to a maximum load.

It is especially noticeable that the curve begins at [illegible] lute zero, while with Mr. Edison's early meter of the electric motor type, and others that have followed this principle, the theoretical curve is as shown by the dotted lines. [illegible] curves deduced, as are the above, from long practical work [illegible] performance of any other meter.

It is proper to say in this [illegible] of error from these causes is practically constant for all sizes of the Edison meter.

The meter case is made of well-seasoned hard wood specially prepared to expel air and prevent warping, and to maintain high insulation; the door of heavy sheet iron properly lettered and numbered. This is held closed [illegible] metallic button turning upon a small post, both passing through a vertical opening. The wire of a lead se[illegible] passed through the button.

The conductors enter and leave the meters through holes in the side or bottom, about two or three inches apart.

The thermostat is required for all meters situated in location where the solution is likely to [illegible] nished as an extra attachment, and may be inserted in any size meter, and [illegible] bringing the two contact points together, closing a [illegible]

[illegible] amperes, [illegible] lamps; 40 amperes, 160 lamps; 80 amperes, 320 lamps.

[illegible] the following table of [illegible] meters.

[illegible]

In selecting the proper size of meters for certain customers it is borne in mind that a meter plate has, like a storage [illegible] maximum capacity in ampere hours per month. The standard found most de[illegible] per month per ampere [illegible].

[illegible] is therefore understood to be [illegible]ted to an average work of one or two hours per day [illegible] maximum load, which corresponds with practical [illegible] for an average of three to four hours daily, the load should be about 20 per [illegible] at 25 per cent [illegible] farther reduction should be made to determine the proper limit for a given plate.

The meter is in practice placed in all sorts of positions. The general instructions simply provide that it should be [illegible] clean and dry, inside the service fusible cut-out, and [illegible].

The initial preparation of plates consists simply in thorough cleaning, covering the top and about an inch of the [illegible] amalgamating and drying [illegible] weighing and tagging of the positive plate, and placing in the solution.

When removed, the plate is re-weighed, and where two [illegible]s are used their weights are compared by the meter man and his record sent to the bookkeeper or superintendent.

The loss in milligrammes sustained by the positive plates [illegible] multiplied by the meter constant, which gives the [illegible]. The constant is found as follows:

Let $ equal price of one standard lamp per hour.

C equal ampere capacity of standard lamp.

Then current through the bottle equals $\frac{C}{975}$

[illegible] 1.224 milligrammes [illegible] represented by one [illegible] is equivalent to $\frac{1,224\ C}{975}$

[illegible]. Hence the price for current [illegible] has removed one milligramme of zinc will be:

[illegible] $ × 975 / 1 224 [illegible] equals constant

[illegible] —Nearly a year ago a series of ex[illegible] in the laboratory of Mr. [illegible] to determine whether in the light of years of experience since the initial experiments upon which the first [illegible]s were based, advantageous changes can be made.

The first result of these tests was the perfection of the [illegible] Edison stations [illegible] at once in[illegible] of terminals, making [illegible] to connect from either side or from below, followed after. Then the production of pure chemicals by the Edi[illegible]boratory, and the elimination of the error due to ox[illegible]ferred to by proper treatment of the solu[illegible].

[illegible] held Decem[illegible] the discontinuance [illegible] amperes, and [illegible] a proper change [illegible]ing spool in each case. It was found per[illegible] the shunt resistances and weigh [illegible] than heretofore, thereby effect[illegible] large plates [illegible] ess in units of what [illegible] percent[illegible]

[illegible] of one bottle in [illegible]

[illegible]

Average number of lamps [illegible] stations .... [illegible]

Average horse power [illegible] .... [illegible]

Average number of [illegible] stations .... [illegible]

Average [illegible] lamps [illegible] .... [illegible]

Total cost of operation [illegible] .... [illegible]

Average annual cost [illegible] operation [illegible] meter .... [illegible]

Average annual cost [illegible] operation [illegible] .... [illegible]

It is also of interest to note that of the twenty-three stations equipped with meters for the measurement of 75 per cent. of their entire lamp capacity, and relying upon these meters for the amounts of their bills to consumers, four are earning upward of 15 per cent. on their capital stock; three others between 10 and 15 per cent.; three others between 8 and 10 per cent., and eight more between 5 and 8 per cent. on their capital stock. Others have been operating for too short a time to yield definite results.

THE DISCUSSION.

THE CHAIRMAN: I am sure the institute is to be congratulated on the lecture this evening; and that we should be very grateful to Mr. Jenks for the pains he has taken, and the elaborate preparations he has made, and for having given us all a great deal of information, which probably few, if any of us had, as to the practical experience with these electrolytic meters. The subject is now open for discussion.

MR. BRADLEY: I would like to call Mr. Jenks' attention to the fact that he did not fully summarize the smallness of the error due to the comparative resistance of the bottle and spool, combined with the shunt. The resistance of the bottle and copper spool combined being 975, there is a very small error, which is not fully explained.

R. W. POPE: We have seen from the diagrams which have been thrown upon the screen, that Mr. Jenks has utilized the various properties of the electric current in many different, and I must say, very ingenious ways. Many of these experimental meters are probably not practical; but I am sure they all tend to show the remarkable fertility of Mr. Edison's inventive mind, and it has been very interesting to me, especially in comparing the experience in electric meters, with those used for other purposes which have had discredit thrown upon them, and I think, rather unjustly. I have had some experience with the gas meter, and I must say that I have always found it very accurate. I used to read one in the Western Union Building. True it was not used very much in the summer, but it ran on for four or five months, and the bill would come in for perhaps 25 cents. Once in a while the bill would be larger than the average, and upon investigation I would find that some one had been working at night. But there is one important point about this meter. It is going into a certain field where there has been nothing of the kind before, and that is in power service. All power service, as you know, is furnished under contract, so much a year, or so much a month per horse power; but there is always a question whether a man gets 6 horse power or 10 horse power, whatever the understanding may be; and they judge by the width of the belt, and the tightness of the belt, as to how much the customer is taking. Then again, a man may pay for six horse power in one day and not use it at all. In printing offices the presses may be idle all day, but they have to pay for their power all the same. In this field it certainly should prove a very desirable instrument. Then in domestic service, we can all see the benefit of using a meter. For a residence the contract service will not answer at all. So far as I know, the contract price at which incandescent lamps are put out precludes their use in private families, where light is most desirable. I could not help thinking, when I saw the pictures thrown upon the screen, what a long road Mr. Edison had traveled over, and how much trouble he might have saved if he had only permitted himself to be guided by the experience of John Gilpin who rode through Cheapside "and hung a bottle on each side, to make his balance true." Mr. Edison has got his meter down to two bottles, and we have been shown to-night that the instrument is true.

MR ROBERTS: I would like, if Mr. Pope will allow me, to take one of his remarks as a text. We had an electric light company in Cheyenne, and I blackguarded the gas meter with all my power. Then we bought up the gas company. I had to send bills to the gas people, and the customers remembered it, and it was a difficult thing to get out of. When I went to prove up the meters, while one of them registered in favor of the company, nearly every one was in favor of the consumer about 3 per cent., and some considerably more than that. As the tendency is to buy up the gas companies by the electric light companies, and not the gas companies to buy up the electric light companies, it is not advisable for any man to get into that fix, if he can possibly help it. I would like to ask the lecturer if there is any basis for the length of time to weigh up and do all the registration necessary, say, on 100 meters; the time required to do the manipulation necessary to arrive at the figures.

MR. JENKS: I think, perhaps a fair approximation that [illegible] which were given on the [illegible] and the average expense [illegible] on an average in [illegible] expense being $1 per meter [illegible] station cost $[illegible] a year [illegible] else required. In [illegible] of that kind would represent [illegible] after the plant had [illegible] of one man [illegible] but I think perhaps [illegible] their ability to do that [illegible] number of lamps of [illegible] at the same time taped

[illegible] the book-

[illegible]

tion gets a little larger a boy is employed to do that merely mechanical work. Then the time comes when the meter man, who should be an intelligent man, does simply the weighing, and all the other mechanical parts of the business are done by a large number of people. Then, instead of making out the bills himself, he simply sends the weights to the bookkeeper or the superintendent; so it comes that we have all the way from, we might say, one-half to three and four or five men employed in the meter business, according to the size of the station.

DR. WHEELER: Mr. Jenks, in describing the three-wire meter, omitted to explain the way in which the two sets of boxes took care of the three wires. I would like to call his attention to that. The current, in going out on the positive wire, for instance, is registered in the positive bottle. It may return through the neutral wire, and it may return through the negative. In that case it is registered in the negative bottles. After returning on the neutral wire, it is registered again. The passage of the current through this wire causes it to consume another 110 volts, so that it would be charged up twice.

MR. JENKS: I neglected to make it plain that the neutral wire acted as a compensation for the meter, as well as for the line service.

MR. CROCKER: The meter is synonymous with fraud in the popular mind. But I think it is more a question of human nature than anything inherently bad in the meter. The gas meter, as Mr. Roberts said, would probably, if tested in New York, be found to be in favor of the customer in at least three cases out of four; and in the case of large errors, they would almost always be in favor of the customer, for the reason that the gas meter is a gas engine; it is worked by the gas, and the gas must flow through in order to work the meter. Now the gas may flow through and not work the meter, if the meter is stuck, or the friction is great, or there is any other fact about it that is antagonistic to the proper working of the meter. Now, something the same is true of this Edison meter; the electric current operates the meter, therefore the current must flow in order that the meter shall record. On the other hand, the current may flow without fully recording its value. In fact in any meter it is almost always the case that the current is much more apt to flow, or a commodity, whatever it may be, gas, water or electricity is much more apt to flow and not record than that a record can be made without any current passing. And I think that fact is forgotten when people condemn meters, because the very nature of the apparatus necessitates that whatever is measured shall pass through in order that it may be recorded. Now, as to whether the company simply reads one thing and charges for another, of course has nothing to do with the meters. It is entirely outside of the theory or practice of meters; it is merely a question of pen and ink. But I think the meter is as accurate as any other practical instrument, and I think that gas is measured as accurately as cloth or milk. And the fraud, if it does occur, and I suppose it does in some cases, is a case of deliberate fraud where the method and apparatus for making the measurements may be perfectly correct; and it is after the meter has done its work that the bookkeeper puts the increment on to the people, which the meter has to take the discredit for. There are so many more people who talk against meters than are in favor of them, that I think a word said now and then on the other side is no more than fair.

LEWIS F. LYNE: I remember in one place where we thought the gas bills were too large we used to put a wooden wedge under the edge of the meter and tip it so as to increase the friction, and in that way we proportionately reduced our bill right off. Not many months ago I was in charge of an electric light station where we had a Crown water meter. Those of you who know how that meter is constructed know that inside is a gutta percha cog-wheel that moves about as the water passes through. We were bothered about getting water, and we thought that the pipe was stopped up with something, and we ran that way for several days; and we took the meter apart, and found that the meter was stuck: during the time the water had failed to record any water, but we had been running a 250 horse power engine.

MR. HOWELL: There is one point in the criticism which Mr. Jenks quoted from the past proceedings, which, I think, ought to be mentioned. The criticism was that only a very small proportion of the current which is sold is measured, that is a 975th part, and that an error in the measurement was multiplied by 1,000, practically. Well, that is true; and yet it is not true. Although we measure a one-thousandth part of the current, and multiply by 1,000, any error in the measurement is not multiplied. If we measure 1,000 part of the current, and multiply by 1,000, any error in that measuring bottle in the resistance of the circuit, in which the measuring bottle is placed, is multiplied by 1,000; but the percentage of the error is always the same, and if we have an error of 10 per cent. in the circuit in which the bottle is, it means an error of 10 per cent only in the result. No matter what kind of meter it is, whether that bottle is in the main circuit or in the shunt circuit, a 2 per cent. error would be a 2 per cent error in every case, and it would not be multiplied by 2,000 per cent. error in one case, as the criticism would lead you to believe. I have watched the introduction of the Edison meter, in one place especially, and I have watched its growth from the very beginning. When the Edison meter was first put into stations, the first thing a man asked was "Is the Edison meter accurate?" And really, there was for some time a diversity of opinion among the Edison people as to whether it was really an accurate meter. But the experience of the users of the meter has been so gratifying, and it has been so much to the credit of the meter, that you very rarely hear its accuracy questioned to-day, in fact, among the Edison electric light people it is not questioned at all. The station which I referred to was at New Brunswick. It started without using meters. They would make a contract with a consumer and give him such light as they thought he would burn at a fixed rate. The more they used this system, the more they were convinced

that they were only getting about one-third as much for their current as they supposed they would get. To overcome that they introduced the meter system, and the result of changing from the contract to the meter system has been a very much diminished output in the station, and very much increased revenue. They get twice as much in return for a given output of electricity as they did before. The accuracy of the meter down there has been checked several times by the customers counting their lamp hours. I have never heard of a case down there in which the customer got the best of the meter, I mean in which the meter was found to be wrong. I know of cases there where the electric meter has checked the gas meter, I mean has differed materially from the gas meter. The customer had his gas light burning, and, in one case, he was getting his electric light very much cheaper than his gas; in the other case the customer was paying very much more for it. In both cases they found, by going back to their gas meter, that one gas meter was charging too much, and the other was charging too little, and the electric meters, in both cases, were right, and one man threw out his gas because he had a slow meter.

Mr. U[illegible]: I would only add to what has been said here about the meter my knowledge of the very long course of experimenting that Mr. Edison went through to obtain the results that we now have. I know that in the early days at Menlo Park these various forms that have been shown on the screen were made and tried. I realize very fully the difficulties in making any mechanical meter, or any meter that will not stick at starting. I do not think that those who have given attention to the meter have thought that any solution can be found, but that this trouble will come in, except with a chemical meter. In the meters that use the heating, as we have been shown, the sticking of the meter is an uncertain quantity, and is invariably against the company; those meters will never be used. If the error were in favor of the company, I have no doubt they would be largely sold and largely used, but they are invariably against the company. The Edison meter is formed with the zinc plates instead of copper plates, which were first proposed. That represents a large amount of work at Menlo Park, and again at the Edison machine works, in Goerck street; and since then Mr. Jenks has given an immense amount of time to it, so that it has to-day been built up into an instrument of most thorough accuracy.

Mr. Edgar: We are using about 800 meters, and I have the utmost confidence in them. I have tested a great many, and I have had our customers test them for us. I have known of numbers of cases where they have proved within 1 per cent.; and I never have known of a case where we had to retreat from the position which we had taken, that the meter was correct. We have had a great number of meters, and are able to determine just exactly the horse-power hours per month of each meter; thus being able to make a contract price in the next case which would be more satisfactory than if we had not made those tests. One gentleman asked a question to-night as to the cost of a meter station. We have, as I say, 800 meters in the Boston Edison station. In that department there are five men; three of them are practically boys, who go around town collecting bottles. We extend over a territory nearly three miles from one extreme to the other. Of course, the traveling is more than it would be for a different-sized station. The fourth man does the weighing, and the fifth man makes out the bills and sends the bills up to the bookkeeper, ready to be mailed, so that we really do more in the meter department than is usually done in a department of that kind; because, usually, the bills are made out by the bookkeeper. It costs, perhaps, $2,500 a year to take care of the 800 meters; but a great many, as I say, are on meters where we are experimenting, making changes once a week, so as to get at a fair average for different classes of work.

Mr. Howell: I suppose every one here knows that there has been a great deal of inventive energy wasted on meters. The records of the patent office show an enormous number of mechanical meters—and I think the Edison company have had about as many presented to them as anybody has—and the great point in favor of the Edison meter, as compared with any other meter, is its cheapness. If we want to equip a station with 800 meters, as Mr. Edgar says his station is equipped, it makes a very great difference if we have to pay for a complicated mechanical contrivance, which is necessarily expensive, or whether we have to buy a box with a couple of pieces of German silver and two bottles in it. The element of first cost is a very strong element in favor of the Edison meter. You can pay for your meters almost as much as you would for the station itself. A successful meter must have two qualities; it must be good and it must be cheap, and I think the Edison meter has those two qualities.

Mr. Roberts: I rather question whether we cannot some day arrive at a mechanical meter which will be satisfactory. So far as cheapness is concerned certainly a Waterbury watch is as cheap as those two bottles and two pieces of German silver, yet there is a great deal of mechanism in it. I wish to bring up one point showing how the customer, if he finds any expense kicking up against him, will want to economize. A station I know of has a 12 by 36 Corliss engine. The lamp renewals are paid for by the company, and the lamps contract price. Everything was running beautifully, and the engine was supposed to be developing about 65 horse power (the indicator card showed about 100 horse power) from 6 o'clock in the evening to about 10; then it dropped down somewhat. The system of charging for lamps being about 75 cents for a lamp, the customer expected it was to burn about 1,000 hours. As soon as he got a bill the indicator card then showed that the average number of lamps per horse power was from six to ten, and that the engine was 75 horse power. Therefore, they saved over 25 per cent. of power just as soon as the customer felt that the lamp breakage alone was being charged against him. I do not doubt the gentlemen who have had the contracting and the meter system besides can show even more remarkable figures than these.

Mr. Brown: Into the construction of this meter there entered [illegible] which there [illegible] Jenks [illegible] nearly [illegible] [illegible] has [illegible] to the best [illegible].

Mr. [illegible]: [illegible] the best [illegible] that can be obtained [illegible] German silver [illegible] standard [illegible] constructed [illegible] is connected [illegible] the resistance [illegible] has to be determined to within a very [illegible] then [illegible] the strip in [illegible] be standardized.

Mr. W[illegible]: I happen to know that [illegible] used in the Edison meters is [illegible] per cent. [illegible] it gives a little [illegible] temperature [illegible] as the temperature [illegible].

Dr. W[illegible]: Do you make any test of [illegible] before [illegible]?

Mr. Jenks: Yes, there are such tests [illegible]. [illegible] ordinary pains are taken to have a good quality of German silver.

Mr. Wirt: I want to say that Mr. Jenks has been extremely conservative in describing the Edison meter as it has been, and not as it is about to be. No changes of a radical nature have been made in the Edison meter since it was first introduced. I may say that there has been practically concluded now a series of experiments on the meter, and they are getting ready to offer a new meter, which will be a great deal better in many respects, that is in the cost of the meter, in the decreased cost of operating, and in the lessened strain on the meter man's back. It appears to us that, given a spool with a piece of German silver, the Edison meter depends on the laws of electrolysis and chemical balance, and the chemical balance is probably the best and most reliable and most sensitive instrument known. So it appears to us that we do not need any large quantity of zinc to weigh or to carry about, and we propose to reduce it one-half, in some instances one-fourth, and in some instances one-eighth, so that the box will be about half the size it is at present. The bottle will be half the size it is now. In place of two bottles there will be one bottle. We will call on the balance for the accuracy we can get out of it, and call upon the meter men for a little more pains.

Mr. Pope: Most of you are aware, probably, that there is to be an exhibition at Paris next season; and in connection with this I would say that various engineering societies here have received invitations to participate in meetings held for various engineering societies on the other side, and the institute has received two letters—one from the Institution of Civil Engineers, and one from the Society of Arts, in London. I wish to read these and bring to your attention the arrangements which are being made by the Society of Mechanical Engineers for an excursion to Europe.

The Secretary then read the communications referred to.

Mr. Pope: About a week after the circulars, of which this is one, were issued by Secretary Hutton, I am informed that they had already received affirmative responses from 75 members; so it appears that it is probable that this arrangement of a special steamer can be carried out. I am in negotiation with him now in regard to the preparation of our own circulars in order to obtain the same facts from our own members. I bring it up to-night in order to give you this information in advance, to guide you in arranging for your vacation. The next meeting of the institute for the discussion of papers will be held on Tuesday, January 8th. The subject of the paper will be "Lightning Arresters and the Photographic Study of Self-Induction," with numerous illustrations and experiments, by E. G. Acheson, electrician of the Standard Underground Cable company.

CORRESPONDENCE.

New York Notes.

New York, Dec. 29.—Work has been begun with vigor on the Bentley-Knight Electric railway in Fulton street, and what is better, it starts off in a manner which gives confidence that it is to be thoroughly done. The two conduits are being laid down in the space between the double tracks, and is finished for two blocks east of Broadway. At the rate the work is being done the line should be completed by February 1st, and when it is put in operation it will "fill a long felt want."

The Brooklyn subway commission has filed its report for the year ended November 30th, from which it appears that the aggregate length of underground conductors has been increased from 1,433 to 2,028 miles. There still remain, however, 5,111 miles of aerial conductors. The district messenger and Gold and Stock wires are on housetops, where they have been permitted to remain for the present. As the commission is quite liberal in its permission for telephone distribution wires, it is presumed that a large proportion of the 4,176 miles of aerial telephone conductors will be allowed to remain. There have been removed during the year 225 poles carrying about 50 miles of wire. There are still about 80 miles of overhead electric light wires, but about half of these will be transferred to the elevated railroad structures at an early day, the companies having leased that privilege which, in New York city, is held by the Western Union Telegraph company, and which has proved exceedingly convenient to the latter.

The board of aldermen has voted to grant the privilege of using the electric motor on the Fourth avenue line in this city, and unless the ordinance is vetoed by the mayor [illegible] company should pay the city for the right.

[illegible] showed that the pressure of traffic at morning [illegible] passengers. Then it appears that the following train [illegible] sometimes [illegible] are [illegible] shut [illegible] safety.

The [illegible] of this city has [illegible] there is to [illegible] Westinghouse companies were on the point of consolidating. This story appears to have originated from a movement toward the consolidation of some of the Edison affiliated companies such as the lamp company and the machine works. This appears the more probable, but whatever truth there may be in the reports, they will certainly not be given much credence until they appear in some more substantial form than has yet been the case.

A new company has been formed in the city called the West Side Electric Light & Power company, which has a good field before it if it can make peace with the Board of Electrical Control. It has a fine field for domestic incandescent lighting, and is expected to use the alternating system.

Freeland Devlin, 17 years of age, an American District messenger, was ordered out last night with a message from the Thirty-fourth street office, by the night clerk Wm. Boby. He claimed it was not his turn, and asked [illegible] another boy take it on his way home. Boby insisted that he should go out, and an altercation ensued, in which [illegible] was struck over the head with a [illegible], the blow fracturing his skull. He was taken to the New York hospital, and his condition is critical.

St. Louis, Mo.

St. Louis, Mo., Dec. 27.—The office of the [illegible] Telegraph & Cable company has been moved from the Mitchell building on Third street to 410 Olive street. The change was made without the slightest interruption to business, notwithstanding the fact that the company has seven quadruplexes, three duplexes, and eight single [illegible].

Judge Valliant last week overruled the defendant's motion for a new trial in the case of the St. Louis & Tennessee River Packet company against the Western Union Telegraph company. This was an action for damages for failure to deliver a telegram sent by the captain of one of plaintiff's steamboats from Cairo to the plaintiff's general manager at St. Louis, asking instructions, and in consequence of which non-delivery of the telegram the plaintiff's boat was detained several days at [illegible]. The plaintiff asked for $355 [illegible], and the jury awarded [illegible].

In the city council last week Mr. [illegible] but authorizing the construction of the [illegible] Southwestern Electric Railway company [illegible] routes. Beginning at the intersection of [illegible] Wash, west with [illegible] Railway company to Sixth street [illegible] company's tracks to [illegible] Northern Central tracks to Locust street [illegible] Union depot [illegible] south over the tracks of the Missouri Railway [illegible] Market, thence [illegible] way to Elm street, thence west on [illegible] St. Louis Railway company's tracks [illegible] to Chauteau; thence west [illegible] street, thence over [illegible] to Twelfth street, thence west [illegible] west on [illegible] street crossing the [illegible] souri Pacific & San Francisco railroads, west on [illegible]

[illegible] be at least twenty feet high in the clear, thence [illegible] to a point opposite [illegible] intervening block to [illegible] Mississippi avenue to Park [illegible] Park avenue to California avenue, thence south to Rappahannock, thence west with single [illegible] Tower Grove Park, returning from the intersection of Grand and Rappahannock streets, [illegible] along [illegible] avenue to Shenandoah [illegible] east on Shenandoah to California [illegible] intersection of Seventh street and Clark avenue, thence east to Broadway, with [illegible] St. Louis Railway company's tracks to Wash street. The proposed incorporators are not mentioned in the bill, but it is understood that the Southwestern Improvement association favors the bill.

C.

Kansas City, Mo.

KANSAS CITY, Mo., Dec. 28.—The great snow and sleet storm of last Wednesday created great havoc with the wires in this city. The telephone company was the greatest sufferer. Every wire in the Grand avenue circuit, which is one of the largest in the city, is on the ground, and every pole on Grand avenue, from Independence avenue to Seventeenth street, is down. On Main, Delaware, Ninth, Sixth, and all the down-town streets the wires are broken and mangled in every block. In the bottoms almost every telephone is shut off, and several hundred wires and many poles are down. All the Wyandotte wires are down, and all out of town connections are cut off. Superintendent Smith of the telephone company said that the loss would [illegible], and that it would be two or three weeks before the service would again be in good order. The company has a large force of men at work. The fact that some of the poles are broken off, and that poles of the size used are very hard to get, will make the work of repair slower than it would otherwise be. The damage was great on Grand avenue. On the west side of that thoroughfare were 100 wires, most of them belonging to the telephone company, and these are all down between [illegible] streets. A great many of the poles were broken off below the cross arms, and it will take several weeks to repair the damage. When they fell Chief [illegible] had them cut where they crossed cable lines. There are 110 wires strung along the west side of Walnut street, but they stood the strain. About sixteen poles were broken on Grand avenue, and the crashing noise they made when falling could be heard as far east as Harrison street. The electric light company says that its wires are not badly broken, being damaged only where the telephone wires fell upon them. The company has a force of twenty men at work assisting the telephone company's linemen. The telegraph wires in the city, although they did not suffer as much as the telephone circuits, were in bad shape. In many places they were pulled down by the telephone wires, and some telegraph poles went down. The Western Union poles at Second street and Broadway fell, making a bad tangle. The linemen of the telegraph companies commenced work as soon as the wires broke. It will be several days, however, before they can finish their repairs. Kansas City seems to [illegible] greatest damage to [illegible] Chicago and St. [illegible] morning, Chicago being [illegible] market reports [illegible] throughout Western [illegible] and eastern [illegible] a message [illegible] It will be a week [illegible]

Cable railroad, and delayed travel several hours. A small wooden house near Wyoming street was demolished by a falling pole. No one was in the house at the time. An electric wire became grounded at the corner of [illegible] avenue and Santa Fe street and set the pole on fire. Chief George Hale of the fire department says the telephone, telegraph and electric light companies have stretched such a labyrinth of wires along all the business streets of this city that it seriously interferes with the fire service, making it almost impossible to raise ladders or throw streams into the second and third story windows of business houses, and often necessitating the cutting of wires, which retards the firemen in controlling a fire, besides subjecting the firemen, pedestrians, and cable cars and vehicles to a great deal of inconvenience and danger. At the last session of the legislature he asked for some action on the part of that body looking toward relief in the matter, setting forth the objections to the aerial system of stretching wires, and advocating the adoption of the conduit system used in Chicago. The telegraph and telephone companies fought the bill and it was pigeon-holed, as was also an ordinance having the same object in view. He is of the opinion that it would save the companies a great deal of money in the long run, be safer to the general public, and give more satisfaction to their patrons. He cited the damage done to the wires during the cyclones that have visited the city, and the annual sleet storms, and went on to say that at times, when the best of service was needed, the local service was practically useless.

Dr. Wellington Adams, the inventor and electrician of this city, was recently asked if he thought death by electricity is painless. "No, I do not think it is," he replied. "If the promoters of the revolution wish to find a painless means of death they should ignore electricity, for there are many more simple and effective agents, notably chloroform, which produces paralysis of the cardiac or heart center. It never has been, and cannot be, proved that death by electricity is painless. On the contrary, there are many reasons for believing it very painful. Those who have accidentally received shocks sufficient to cause death, and who have been revived by the timely exercise of restorative measures, pronounce the shock and their sufferings indescribably excruciating. From practical experience I can substantiate these statements, for in the course of my experiments I have many times received shocks of sufficient intensity to knock me down. I assure you that the sensation can be truthfully likened to the kicks of a thousand mules, with each foot implanted in a spot of its own. Of course death by electricity is very sudden, and there is little time to linger and contemplate the suffering. The same may be said of hanging, but in either case the shock and pain are experienced. With chloroform no such experiences are recorded; therefore, why not kill by chloroform?"

"Then you do not consider death by electric shock less painful than hanging?"

"I certainly do not, providing the hanging is properly performed. In either case there is a violent and necessarily painful shock, but in both cases the victim's suffering is more from contemplation of the probable shock and pain to be inflicted than from the actual experience, and certainly this horrible dread and the consequent suffering are not destroyed or even mitigated by an anticipation of a violent electric shock."

"How, in your opinion, should the operation of electrical execution be performed?"

"The two electrodes, or circuit terminals, should, and in all probability will, be applied to the head and cervical portion of the spinal column. These should be covered by moistened chamois skin, and have as large a contact surface as possible in order to avoid burning and mutilation of the skin, and effect as low a resistance of the circuit as possible."

John A[illegible]berger, manager of the Western Union Telegraph office at the Union depot, was united in marriage [illegible] to Miss Jennie Dale Pierce of New York city, at the groom's residence on Tullis court. H.

Louisville, Ky.

LOUISVILLE, KY., Dec. 26.—The Gaynor Electric company, which was recently established here by northern capital, [illegible] electric railway contracts aggregating $[illegible]. The larger of the two, that of the [illegible] company, was for an equipment of [illegible] miles of railroad. This company has [illegible] weeks made shipments of [illegible] to California, Iowa, Wisconsin, Ohio, Tennessee, [illegible] Pennsylvania. In July last [illegible] negotiating for additional [illegible] point.

[illegible] been placed in the [illegible] city. It registers the [illegible]

[illegible] residents on Third and Fourth avenues and Broadway, talk of placing the electric light in their homes.

Electric wires are being strung on the four sides of the city hospital for the purpose of lighting with electricity the extensive grounds of the institution.

The chief of police here is planning a new patrol box system for the city. It is thought that the plant will cost at least $45,000. An ordinance authorizing the construction of the system will shortly be presented to the city council, and lively bidding may be anticipated.

Workmen yesterday began putting in the electric lights on the steamer James Guthrie, lying in the Louisville harbor. All the steamers of the Louisville, Evansville & Henderson line will be lighted by electricity. At the last meeting of the school board, the trustees adopted a resolution to place in the school on Kentucky street the Johnson electric heating apparatus, at a cost of $1,400. The ferry steamer W. C. Hite, plying between this city and Jeffersonville, will be lighted by sixty electric lights.

The Gaynor Electric company of this city has closed a contract with the Chattanooga Electric Street Railway company for furnishing the apparatus for six miles of road, running from the city to the base of Lookout mountain. The amount of the contract is $30,000, and it is the largest of the kind ever let in the South. The Chattanooga road is to be of the same character as the electric road about to be started on Green street in this city. It is to be operated from an overhead wire.

Louisville offers a fine field for the electric light men, as the modern system of illumination has not been pushed here. There are two electric light companies in operation, the United States using the Brush. A number of business houses have dynamos.

The city council of Lebanon, Ky., claims that it has been charged too much for the street gas lamps. It is now proposed to use electricity, and the councilmen are investigating the matter, and receiving offers from electric companies.

The city council of Fulton, Ky., is considering a proposition to light the streets by electricity.

The mayor of Paducah has returned the ordinance granting a right of way to the Paducah Gas Light company for an electric light system. He added that the company had declined to accept the provisions of the act. The Citizens Electric Lighting & Heating company will, however, ask for a franchise at the next meeting of the council. Nat Harman, the agent, says that he will begin construction as soon as a franchise is granted.

Maysville, Ky., is to have an electric street railway, one and three-quarters miles in length. The city council is considering the matter now, and will very shortly ask for bids. The line will be owned and operated by the city. The electric plant for the illumination of the streets is almost completed. A.

Fords, Ky., with less than 1,000 inhabitants, situated on the Kentucky river, near Winchester, has bought a small electric light plant, and will hereafter illuminate its streets by that means.

The Newport, Ky., Electric Light company has been incorporated. It has a capital stock of $50,000. The incorporators are Elwood Livezy, Samuel Bigstaff, John B. Taylor and J. J. Hetsch.

Winchester, Ky., is now lighted very cheaply by means of electricity. A dynamo is run by the engine of a flour mill. A handsome profit is made by furnishing lights at $1 per month.

A few miles from Pineville the Louisville & Nashville railroad is excavating for a tunnel which will be over a mile in length. Gangs of men are working at both ends, and their light beneath the earth is furnished by an electric plant. The Louisville & Nashville company has shipped from Louisville all the machinery and set it up here in the mountains, employing experts to attend to the work. The illumination serves its purpose splendidly.

The Langstaff [illegible] company of Paducah will install a an electric lighting plant to illuminate all its mills and yards.

Hopkinsville, Ky., is considering the question of purchasing an electric light plant. It is proposed to hold a meeting of the citizens at the court house to see what is the sentiment of the people concerning the matter.

Los Angeles, Cal.

LOS ANGELES, CAL., Dec. 22.—The Los Angeles Electric company put in a bid at the last meeting of the council to furnish the lighting for the next two years on the following terms: [illegible] each with three lamps of [illegible] candle power each, or [illegible] at the rate of $1,-[illegible] for each [illegible] foot mast, with one lamp of [illegible] candle power, at the rate of $[illegible] per annum, [illegible] on the moonlight schedule; also to furnish free of charge [illegible] candle power for the engine houses and police station, the lighting on foggy nights at [illegible] per hour for each lamp, payments to be made monthly. D.

THE ELECTRIC LIGHT.

Middleboro, Mass., contemplates establishing a $25,000 electric light plant.

New Orleans has ordered the erection of thirty-four additional electric lights.

A company has been organized at Chestertown, Ind., for the purpose of introducing an electric light plant at a cost of $7,500.

The Indianapolis Jenney company has sold to the Jackson, Miss., Gas company two 35 arc light machines and complete electrical outfit.

William C. Stevens' new building, 24 and 26 Adams street, Chicago, is being wired for 540 incandescent lamps by the Western Electric company.

The Ashland Electric Light & Motor company of Ashland, Ore., recently organized, has adopted the Waterhouse system of arc and incandescent lights.

The Tuscumbia Mills company of Tuscumbia, Ala., is negotiating with the southern agents of the Waterhouse Electric Light company for an arc plant.

The city electric light works at Springfield, O., were burned recently, and the city left in darkness. The fire was caused by the bursting of a crude oil feeder to the boiler.

The electric lighting of Toronto, Ont., is being extended rapidly. Another addition of 200 lamps to the city plant has been recommended by the council committee on public lighting.

The Philadelphia & Reading Railroad company has decided to illuminate a mile of its tracks in Reading by electricity, in order to facilitate the making up of trains and prevent accidents.

The Westinghouse Electric Light company, which will supply the plant for the Pittsburgh city lighting, has already begun the manufacture of machinery, and will push the work to an early completion.

The contract for lighting the Midland Hotel, Kansas City, has been let to the United States Electric Lighting company, through C. C. Warren, western manager. At least 1,000 lights and possibly 1,500 will be used.

The Perkins Lamp & Electrical Supply company of Chicago has been incorporated; capital stock, $250,000. The company was organized for manufacturing and dealing in incandescent electrical lamps, supplies and machinery.

The Chico Electric Light works recently destroyed by fire were owned by the Electric Light & Motor Manufacturing company of Chico, Cal., incorporated last June with a capital stock of $100,000. The loss is estimated at $20,000; insurance, $8,800.

The committee of the house of delegates, St. Louis, on putting telegraph and telephone wires underground, met last week. The subject is now being considered in both branches of the municipal assembly. A bill applying for a conduit franchise is pending in the council.

The "Primer of Electricity" contains the following definition of electric lights: "There are two kinds of electric lights, namely: *Our* kind and the *other fellow's* kind. Our light is much lighter than the other fellow's light. The other fellow's light is surrounded by a cloud of non luminous verbosity."

The superintendent of the waterworks and electric light department of Dunkirk, N. Y., has made a report to the effect that the average cost per night for each electric light in the city plant is 13 cents. These lamps are burning 12 hours, 46 minutes, nightly. The city plant was put in by the Western Electric company of Chicago.

The storage batteries for the installation at the residence of Potter Palmer, Chicago, have arrived, and work has been already commenced under the direction of Messrs. Conant and Hood, representing the Electrical Accumulator company of New York. They anticipate having the plant in operation before the specified time, February 1st.

The Madras *Mail* says that Dr. Thurston, the superintendent of the Madras museum, has been requested by the board of revenue to visit various electrical establishments in Europe in order to select an electric globe light to shine in 20 fathoms of water. Such a light is wanted at the pearl fisheries, for up to the present the work of the fisheries has been confined to comparatively shallow banks.

Among the recent installations of the Thomson Houston company are the following: McMinnville, Tenn., 35 light arc; Fremont, O., Electric Light & Power company, increase of 35 arc lights; Baxter Springs, Kan., 500 light alternating system; J. C. Hubinger, Keokuk, Iowa, 1,000 light alternating system; San Louis Obispo, Cal., 500 alternating light plant; North Chicago Street Railway company, 100 incandescent lamps.

The city council of Falls City, Neb., is considering the matter of electric lights. It was offered ten lights for $100 per month, and the company offered to pay the city $80 per month for the use of steam from the waterworks to run the light plant, the light company to furnish a boiler for both concerns, and house its own machinery. The council rejected the proposition, and now expects, it is said, to sell the franchise for electric lighting.

A writer in the Chicago *Evening Journal* says: "This idea of getting light is just like many other things—the more we have the more we want. A gentleman connected with the gas office, and owning stock, told me that the receipts of the company are as large in the aggregate in the business part of the city as they were when electric lights were the exception. The officers of the company explain it in this way. They say that where a big concern puts in its own plant, and lights the interior and the front by electricity, it demands more gas jets in the alleys and in the rear to keep the shiner in front from making those places look dark and dangerous. Then, too, the places either way on the street require extra lights or they will take on an Egyptian darkness. In this way the places with plants often require some additional gas lamps, and the neighborhood [illegible] many [illegible] larger [illegible] consume gas."

[illegible] resolution [illegible] the common council [illegible] the [illegible] plant to the Indianapolis Jenney company [illegible] has been [illegible] that body [illegible] committee [illegible] advertise for the purchase of a plant, after [illegible] successfully operated for one year, also, for [illegible] ninety [illegible] the rental system [illegible] the whole subject [illegible] gone into [illegible].

Fire was discovered in the electric light and power station at Lima, O., shortly before [illegible] before the arrival of the department the flames had gained considerable headway, and a total destruction of the works was feared. This was happily averted, however, and a large force of men set to work immediately repairing the damage. At 4 o'clock the same afternoon the Silvey generator, which furnishes current for the electrical railway, was started and the cars were once more in motion. The lights in the business houses and private residences were in operation that evening, and within twenty-four hours the whole system was running as smoothly as though nothing had occurred.

The new Edison electric light station in Philadelphia will soon be in operation. It is six stories high, and was erected at a cost of $150,000. On the first floor will be placed twenty engines of 250 horse power each. On the second floor there will be forty dynamos, with a total capacity of 60,000 lights. The third floor will be used for the workshop; the fourth floor for ten boilers of 500 horse-power each. The fifth floor will accommodate 1,000 tons of coal, which will be fed by pipes to the furnace under each boiler. The sixth floor will be devoted to the general offices of the company. The Edison company's total investment will aggregate $1,000,000, including eighty-four miles of underground wire.

In the court of appeal in London December 6, the argument on the appeal in the case of Edison & Swan Electric Light company against Holland and others was continued. The case of the appellants was concluded, and Mr. Finlay addressed the court on behalf of the defendants. Among other things he said in reference to the process of making filaments, that the principle was not new, and that the processes were worthless. He claimed that the specification was insufficient as had been demonstrated by competent evidence, and that fact broke down the entire case of the appellants. Sir Horace Davey then made an address for the respondents, in which he claimed that no lamp had ever been made in accordance with the Edison patent specification. The court reserved decision.

The action of the Metropolitan Electric Light company in giving the order for their central station to the Westinghouse company, has caused some dissatisfaction on the part of English contractors; but this feeling is likely to subside now that tenders for a second station have been invited, on the understanding that an English firm will receive the contract, says *Industries* of London. The Metropolitan company will thus be in a position to test by actual practical work whether the American or some English system of lighting is the best, and future orders will be given out according to the results of this test. The tenders now invited are for the whole of the generating plant (steam and electrical) required for the supply of 10,000 lamps, and for the transformers, but not for the mains.

An English electrical paper says: At a recent meeting of the International Society of Electricians, held at Paris, R. V. Picon, the consulting engineer of the Continental Edison company, read a paper on "The insulation resistance of electric light installations," in which he recommended that this resistance should in no case be less than 500 E C ohms. In this formula, E is the electromotive force of the dynamo, and C is the maximum current. According to this rule the insulation resistance of a 1,000 light installation, in which the total maximum current would be about 500 amperes, need not be higher than 100 ohms. This is an exceedingly low value, and English electricians will certainly prefer a higher standard of insulation than that which M. Picon seems to consider as satisfactory.

THE ELECTRIC MOTOR.

The Alliance Electric Street railway of Alliance, O., constructed by the Thomson-Houston company, will be in operation in a few days.

The Thomson-Houston Electric railway at Des Moines is operating successfully, and giving satisfaction both to the stockholders and patrons.

The prospect for an electric road at Pittsburgh is good. The electric company, it is said, has purchased a majority of the stock in the Beaver road, upon which it will probably introduce the electric motor.

By its recent extension the electrical railway system of Scranton, Pa., becomes one of the largest in the world. There are eight street railway lines in the city operated by electricity, and all are giving complete satisfaction.

Three Julien Electric Traction company's cars have been operated on Fourth avenue—one seventy days, another forty-two days, and the last one thirteen days. On December 20th the three cars had been operated 125 days, and in that time had run 3,013¼ miles, and carried 35,000 passengers.

The introduction of electric street railways has had the result at least of awakening the horse car companies to the needs of the public. In Detroit where the horse car men have a phenomenal "pull" the Sprague electric railway project has set them all by the ears. Both horse companies have united in their opposition to the Sprague company, and the Detroit *N[illegible]* says, commenting on their efforts: "It will be an honest alderman who retires after his [illegible]

[illegible] overhead system, [illegible]

[illegible]

[illegible] time since we called attenti[illegible]

[illegible] practical [illegible]

[illegible] ter the pool for the purpose of building a mammoth summer hotel and 100 cottages on [illegible] will be [illegible] long, and is [illegible] tion about June 1st.

An original method of reclaiming [illegible] city through the agency of an electrical railway has been conceived by Dr. [illegible] 90 acres of land at the head of Elliott bay near Seattle, W. T. A proposition [illegible] street, by piling across the flats of the harbo[illegible] and then constructing upon it an electric road which will pass through the land just purchased and around [illegible] West Seattle six miles.

The Sprague Electric Railway & Motor company of New York has closed a contract for the electrical equipment of the Chattanooga Electric Street railway. The Electric Street Railway company at Chattanooga has been only recently organized, and the construction of their road will be new throughout. The line will extend over five miles of track, and there are a number of sharp grades which must be surmounted. The system used will be the regular Sprague overhead, with small silicon bronze overhead wire for a working conductor. All the latest improvements in use by the Sprague company and adopted by them on their roads, will be used here, and the cars will be equipped with the new Sprague improved truck. The contract awarded to the Sprague company includes generators and all electrical apparatus complete.

During the last week several experimental trips were run over the East Cleveland Street Electric railway on Cedar avenue, and it is now expected that the road will be in commercial operation and ready to carry passengers in about ten days. This road extends out Euclid avenue, from the city of Cleveland to East Cleveland, [illegible] finest resident streets. The power house is of the finest character, and fully equipped with all the necessary electrical apparatus. It is undoubtedly one of the finest buildings of the kind in the country. The generating apparatus includes four 500 volt dynamos of 40,000 watts' capacity each, representing 375 horse power. The building is so arranged that this can be easily increased, and without changing the line of machinery 1,500 horse power of dynamos can be placed in position.

The discussion over the Detroit franchises for street railways continues to occupy the attention of the aldermen, and at present the Electric Railway company is making the horse car companies trouble. The Woodward Electrical company has made the following proposition to J. B. Corliss, representing the syndicate favorable to electrical railways: "Replying to your inquiry relative to our storage battery as applied to street railway service, would say that we are now prepared to furnish storage battery capable of meeting the requirements of any street railway [illegible] guarantee its success." Captain C. H. Thompson of the Woodward Electrical company makes the following interesting statement in this connection: "With eighty-four cells of our battery, weighing 5,500 pounds, we can propel a street car sixty miles without recharging, and without exhausting our battery. The cost of equipping a street car with our battery and the necessary motors, will not exce[illegible] and the expense of each day's run of sixty miles [illegible] less than $1 for the single item of power."

THE TELEPHONE.

A dispatch from Kansas City says that the physicians and druggists of that city are endeav[illegible] reduction of the present rates for telephon[illegible] ening to remove their instruments [illegible] demand is complied with.

Aspen, Col., has had a telephone exchange only a short time but the system is being rapidly extended [illegible] venience is realized by business men and [illegible] Nearly all the mines are now connected [illegible] ing built into Tourtelotte Park on the top of Aspen [illegible] tain. The wires also run over Smuggler m[illegible] three miles up Hunter creek to K[illegible]

Over 800 [illegible] telephone [illegible] to the Missouri Bell Telephone company [illegible] phone company after the decision of the [illegible] preme court, were cast into the [illegible] Chamber of Commerce building [illegible] Louis subscribers of the [illegible] company [illegible] itself delivered the instruments without contest.

Miscellaneous Notes.

The Westinghouse Electric company contemplates re- [illegible] New York City, where its [illegible] its present quarters.

[illegible] company, of New Orleans, composed of the leading capitalists of the city, has just been formed to introduce a thermostat system in [illegible].

[illegible] company of Chicago has [illegible] with a capital stock of $130,000 [illegible] O. Meyer, William S. Bates, Andrew J. Egbert.

[illegible] company of San Francisco [illegible] and expect to have completed about April 1st a manufactory for storage batteries. The building will be 300 feet long fronting on the bay. This company has the agency for California, Oregon, [illegible] Washington Territory, Idaho and Arizona for the patents of the Electrical Accumulator company of New York.

[illegible] has lately been conducting experiments to determine the action of an electric current on vegetation. The soil experimented on was divided into [illegible] thirty centimeters broad and two meters long being placed at opposite ends of each square. The line was carefully insulated, and five cells were inserted in the circuit. The test was kept up [illegible] corn, potatoes nor any other vegetable or cereal were affected in the slightest degree.

[illegible] National Electric Light association [illegible] directions which must be followed by those who desire to take advantage of reduced railroad rates to the Chicago convention. Tickets [illegible] three days prior to, nor three days later than, the opening of the convention [illegible] rate will be purchased, and the agent at the place of purchase will give a certificate to that effect. Tickets will be sold in Chicago at one-third regular rates upon presentation of the certificate [illegible].

Business Mention.

[illegible] of New York have issued a handsome calendar for 1889.

The Woodward Electrical company, owing to the increasing demands for the Detroit storage battery, have been compelled to secure more extensive quarters for their factory. They will increase their working force to 125 hands. The building, which is to be three stories in height and to have a frontage of ninety feet, running back [illegible] Michigan Central tracks, will be thoroughly equipped for the manufacture of cells used in storing electricity.

Following is a list of central stations using the Heisler [illegible]

[illegible]

The Goodrich Hard Rubber company of Akron, O., will forward upon request a large illustrated catalogue of the goods they manufacture, with net prices of sheet, rod, tubing and all shapes [illegible] used by electrical companies. Specialties are not listed, but estimates will be gladly furnished if samples or models are sent.

Electrical Patents.

Issued December 25, 1888.

394,951. Telephone Apparatus. Upton H. Balsley, Philadelphia, Pa.

The invention relates to the Law system of telephone exchange, and is limited to constructive details. The last claim is as follows: "A looped metallic call circuit, two subscribers' speech transmitting instruments connected with the looped call circuit, a central station, an operator's receiver in circuit with the looped call circuit, and connecting circuits between the speech-transmitting instruments of the two subscribers independent of the looped call circuit, whereby they may be coupled for conversation, and the looped call circuit used for signaling only."

394,952. Overloading and Slack Cable-stop for Electrical Hoisting Machines. William Baxter, jr., Baltimore County, Md.

A yielding connection is provided between the car and its suspending rope; an electric circuit connects the car with the motor, and a switch placed upon the car is operated by the said yielding connection to stop the motor whenever the car is obstructed in its movement.

394,957. Battery Cell for Electric Belts. Simeon Colling, Oakland, Cal.

394,960. Electric Telegraphy. Mark W. Dewey, Syracuse, N. Y.

The invention relates to multiplex telegraphy, and is designed to facilitate the transmission of messages.

394,961. Telegraphic Printing Code. Mark W. Dewey, Syracuse, N. Y.

The invention is defined as consisting, first, in marks of different lengths; second, in the arrangement in a row at right angles to the line of travel of the paper of the plurality of marks designating a single letter or character; third, in making the marks in each row of corresponding lengths, and, fourth, distinguishing the different letters or characters from each other, either by the difference in the lengths of the marks or by the distances of the marks from the longitudinal edges of the paper.

394,964. Electric Switch Board. Isaiah H. Farnham, Malden, Mass.

This invention comprises the application to any form of switch-board of means for causing a continuous or periodic flow of air outwardly through the several spring jacks thereof, and since the spring jacks of horizontal switch-boards are (inasmuch as they are vertically mounted with their orifice upward) peculiarly liable to be affected by dust and fibrous accumulations, due to the attrition of flexible cords, clothing, and other causes, it especially comprises the application of such means to switch-boards of such character.

394,978. Core for the Armatures of Dynamos. David J. Hauss, Cincinnati, O.

The last claim is given: "A core composed of alternate iron and paper disks mounted on a mandrel and coated exteriorly with a sheet of insulating material, in combination with flexible ends and corners of insulating material."

394,999. Brush for Dynamos. Edwin W. Rice, jr., Lynn, Mass.

By this invention the commutator may be run in either direction without changing position of the brushes.

The sixth claim follows: "The combination, with a revolving commutator cylinder, of a fixed laminated commutator brush having sliding contact with the cylinder, said brush consisting of plates or laminæ arranged in planes transverse to the surface of the commutator plates and bent sidewise at their contact ends in a direction transverse to the planes of the laminations and parallel with the plane of the commutator contact surfaces."

395,015. Electric Meter. Elihu Thomson, Lynn, Mass.

The meter here shown is designed especially for registering the use of alternating currents.

[illegible] are appended: "The combination [illegible] meter, of a current determining [illegible] the circuits at or near the point of [illegible] carrying electric energy [illegible] the proportion of current [illegible] to be measured in [illegible] being controlled or adjusted in its [illegible]

[illegible] electric meter [illegible] converter, one coil [illegible] of the meter, while [illegible]."

[illegible]

[illegible] of a revolving ring [illegible]

shaft, and inclosed by the said armature."

395,028. Flexible Sealed Cell for Secondary Batteries. Mark Bailey and John Warner, London, England.

395,096. Automatic Fire Alarm. Alexander Watson, San Francisco, Cal.

395,101. Signal Transmitter. John C. Wilson, Boston, Mass.

395,102. Signal Transmitter. John C. Wilson, Boston, Mass.

395,111. Fire Alarm Annunciator. William A. Barnes, Bridgeport, Conn.

The invention consists in mechanism for indicating the location of the point at which the circuit has been disturbed within the general area or district protected by the alarm box.

395,112. Electrical Alarm. William A. Barnes, Bridgeport, Conn.

395,116. Rheostat. Sigmund Bergmann, New York, N. Y.

A compound regulator is shown by means of which both multiple arc and series resistances may be thrown into and out of circuit. The last claim is: "The combination, with two electrodes, of two receptacles for liquid conductors, each comprising a number of terminals, resistances in circuit with said terminals, and pistons for varying the height of the liquid conductors in the receptacles, one of said electrodes being connected to direct current to one of said sets of terminals only, and the other electrode being connected to receive current from both said sets of terminals."

395,123. Circuit Controller for Dynamo Electric Machines. Thomas A. Edison, Menlo Park, N. J.

The invention consists mainly in a circuit breaker adapted to break two circuits by the same movement, and also to break one of such circuits before the other, such circuit-breaker being also provided with means for locking it when closed, and for instantaneously releasing it and breaking the circuit when desired.

The first and the last claims are: "The combination, with two or more dynamo electric machines, each having its field coils and its armature coils in separate derived circuits from the same main conductors, of a circuit breaker for each machine, controlling both its field and armature circuits by the same movement and breaking the latter before the former.

"In a circuit controller, the pivoted frame carrying swinging contact plates, in combination with upright terminal plates, between which said swinging plates enter to close circuit."

395,137. Hotel Telephone System. Hammond V. Hayes, Cambridge, Mass.

The first claim reads: "A hotel or factory telephone system comprising a central station, a series of rooms or sub-stations, a series of direct lines, each extending from one of the rooms to the central station, and there terminating in an earth wire after passing through a spring-jack and annunciator, a common return line extending from the central station and branching into all of the rooms, the said line being normally open or disconnected at the central station, an earth branch including a calling battery connected with said return line, a switch and connections therefor at each room permanently united with said return line, and normally connecting the same with the direct line through a call receiving instrument and a resistance, but adapted to transfer the said connection to a second branch of said direct line, including a telephone, a key or button arranged to unite the direct line with the return line, shunting the several appliances of the former, and thereupon to direct the major part of the battery current over the said direct line for the purpose of operating the central station call annunciator, and means for uniting the central station end of the common return wire to any one of the direct wires for the purpose of sending outgoing signals, and to establish a talking circuit."

395,151. Apparatus for Exhibiting or Demonstrating Non-Magnetic Watch Movements. Alvin Lawrence, Lowell, Mass.

395,157. Dynamo-Electric Machine. Frank F. Loomis, Akron, O.

395,163. Device for Automatically Stopping Trains. Ivan L. Meloon and Phineas S. Whiting, Lima.

395,207. Electric Cable Support. Charles H. Bowen, Washington, D. C.

The last claim is appended: "A portable hanger with slot underneath and a groove or recesses on its upper interior surface for the simultaneous passage of the upper and lower lugs, and of the conical divided sleeve clear through the conical hanger, whereby said sleeve may be locked in place by turning the lugs upon the beveled surfaces of the hanger."

395,21[illegible]. Toll Apparatus for Producing Electric Light. Dixon [illegible] Davies, Leeds, County of York, and John M. Tonitel, Westminster, County of Middlesex, Eng.

395 251. Annunciator. Albert Rosenberg, Baltimore, Md.

395,260. Armature for Dynamo Electric Machinery. Warren S. Belding, Chicago, Ill.

Claim 1 is as follows: "1. A hollow cast iron armature core composed of the annular parts hollowed at their meeting sides."

395,2[illegible]. Electric Motor. Daniel F. Sweet, Grand Rapids, Mich.

The object of the invention is to arrange the rotating armature in conjunction with the field magnet or magnets so as to concentrate the magnetic force in the field.

The last claim reads: "[illegible] The combination, with the field magnets of the [illegible] consisting of strips of sheet iron coated with a non-magnetic covering [illegible] pole edges extending above the core of the magnet."

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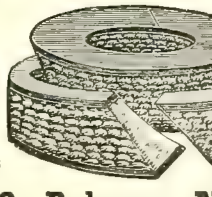

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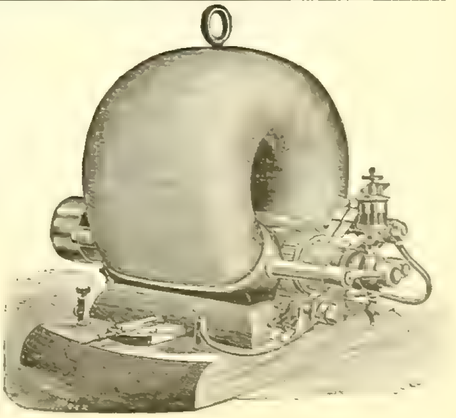

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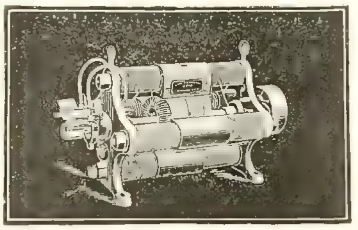

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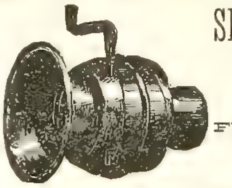

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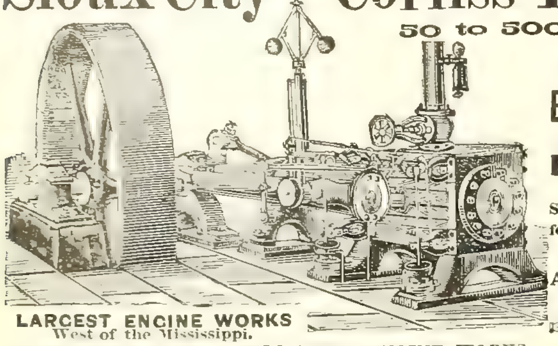

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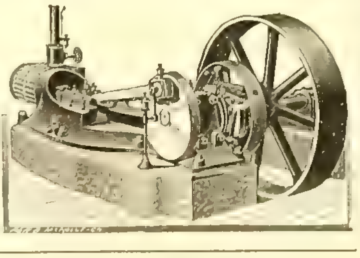

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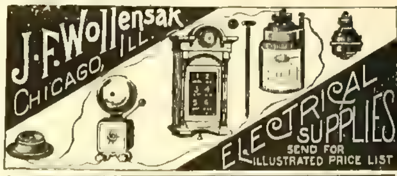

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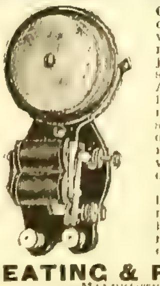

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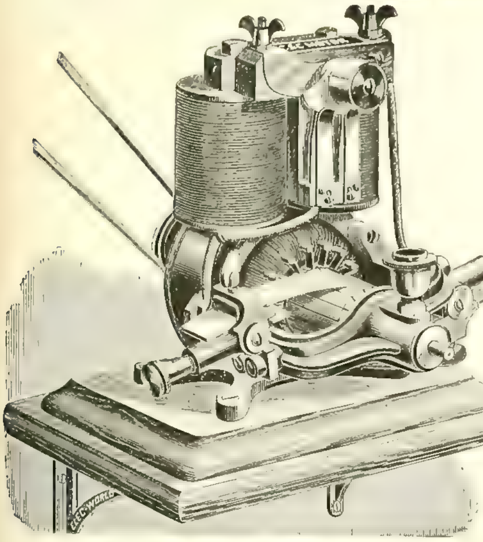

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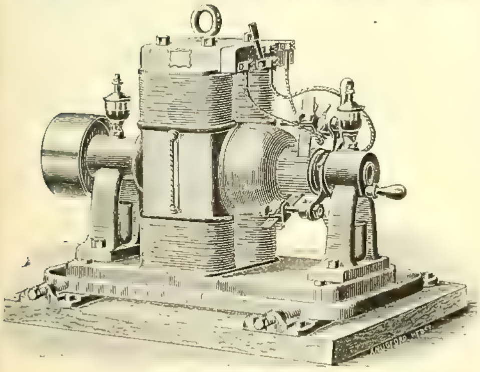

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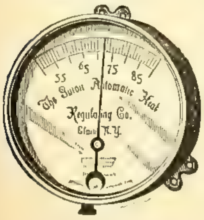

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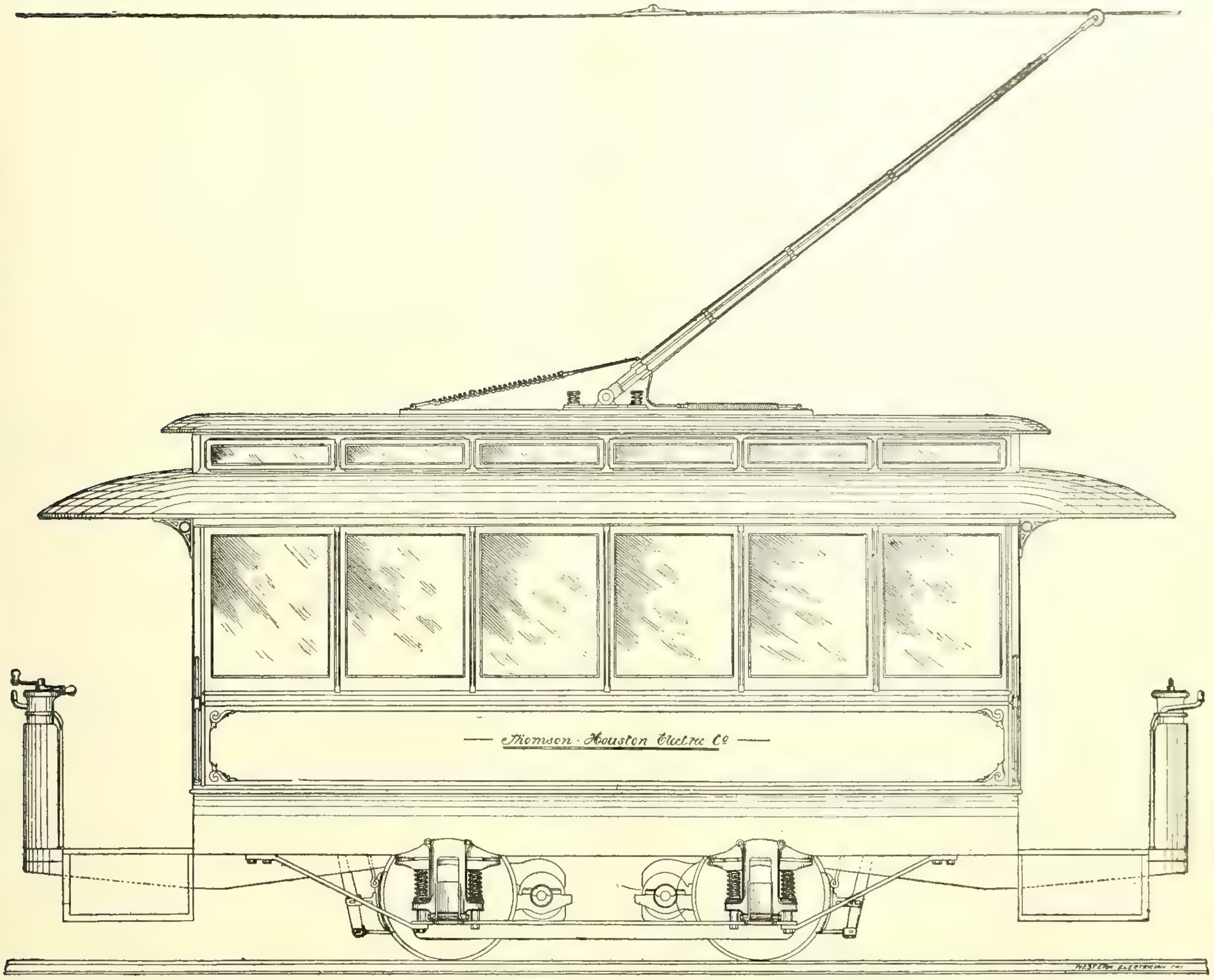

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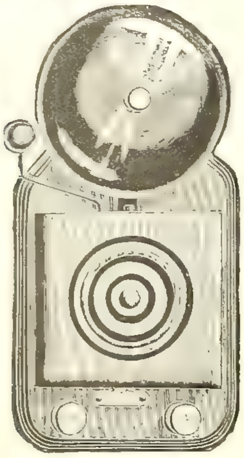

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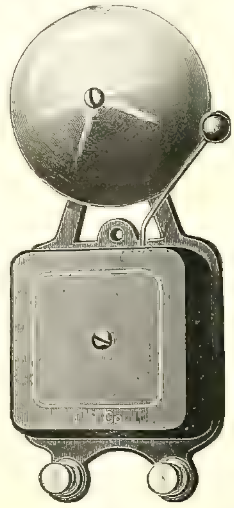

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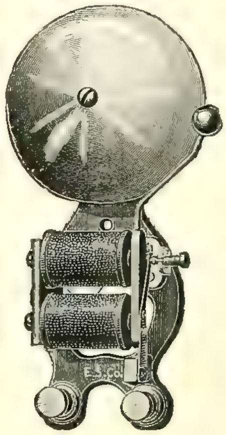

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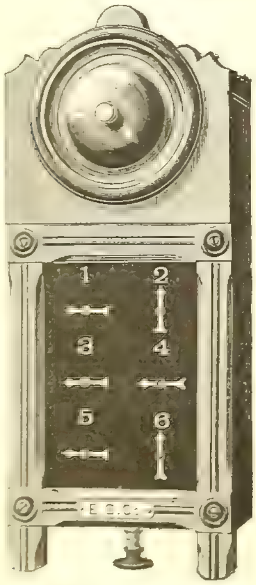

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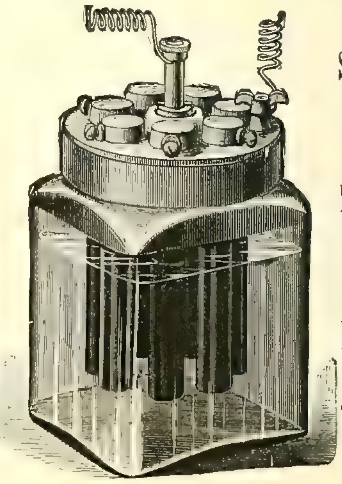

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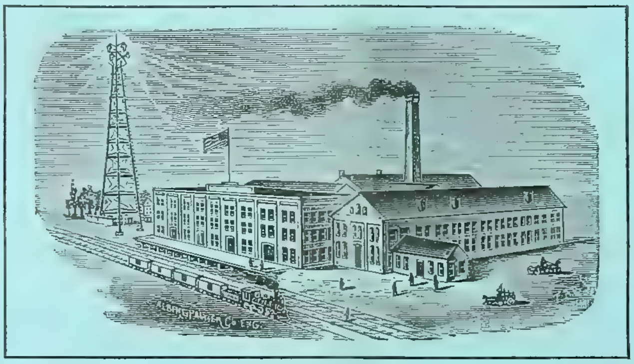

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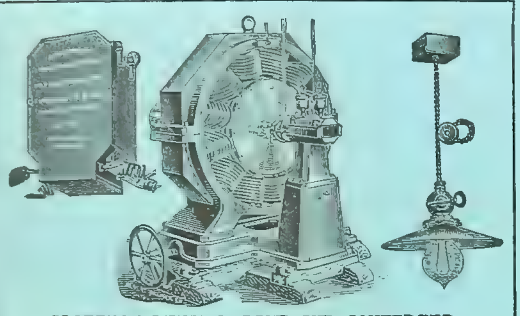

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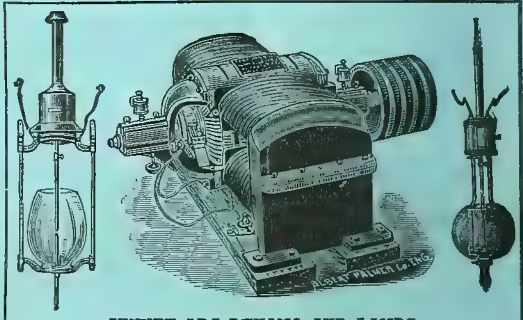

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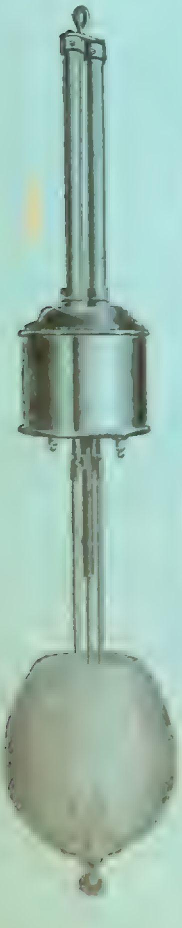

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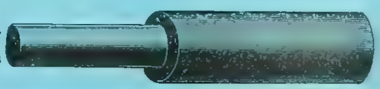

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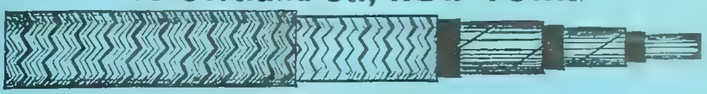

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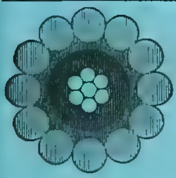

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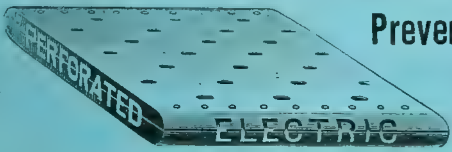

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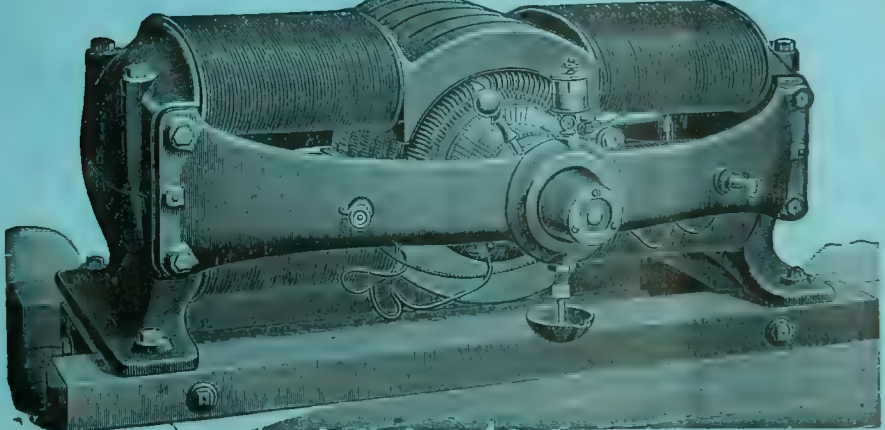

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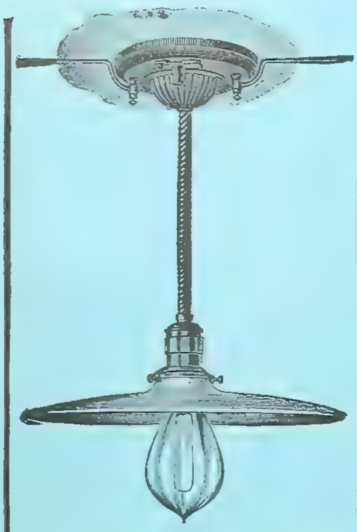

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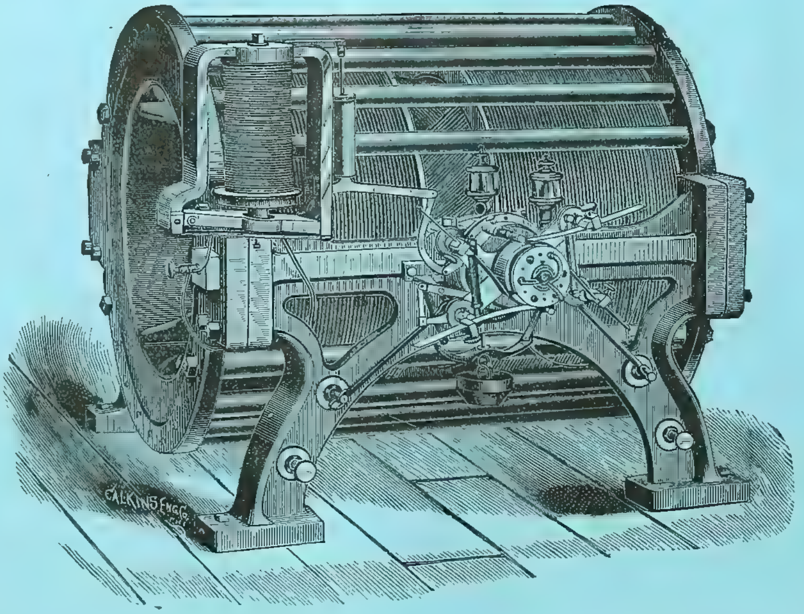

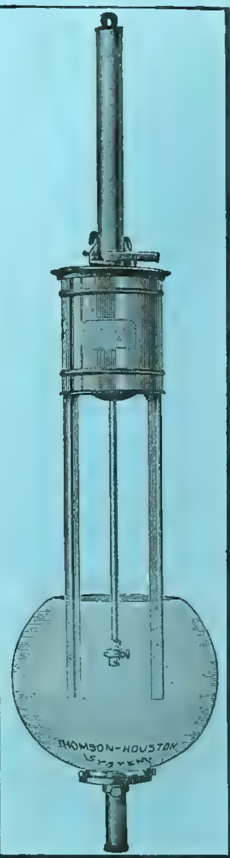

This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

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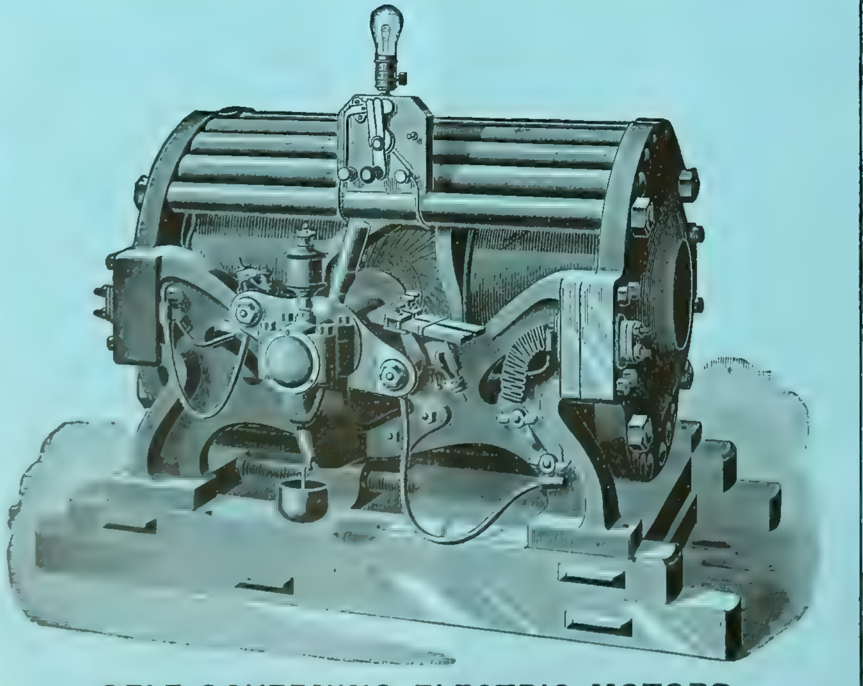

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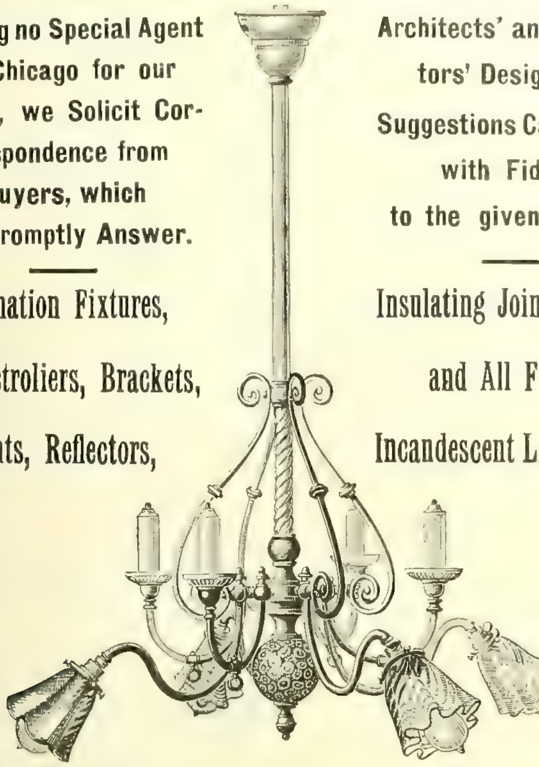

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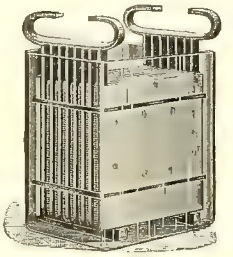

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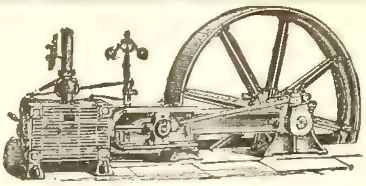

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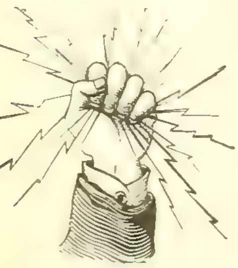

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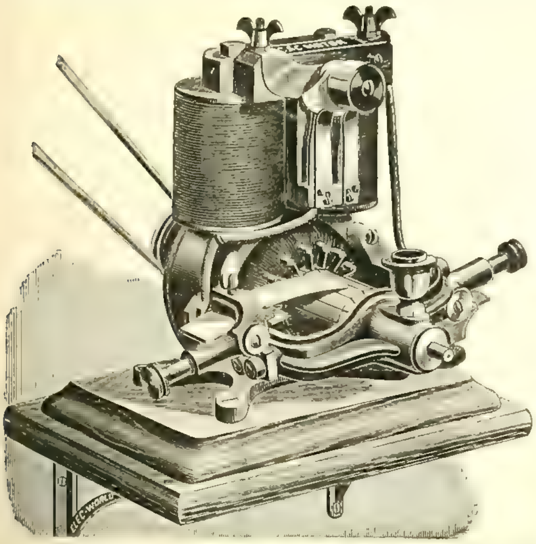

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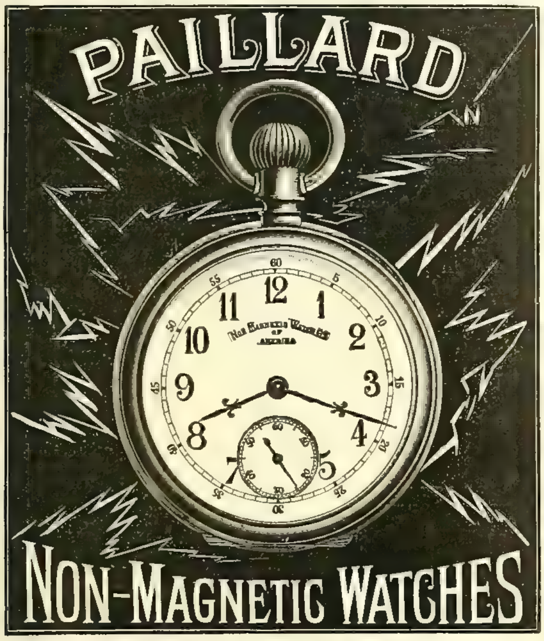

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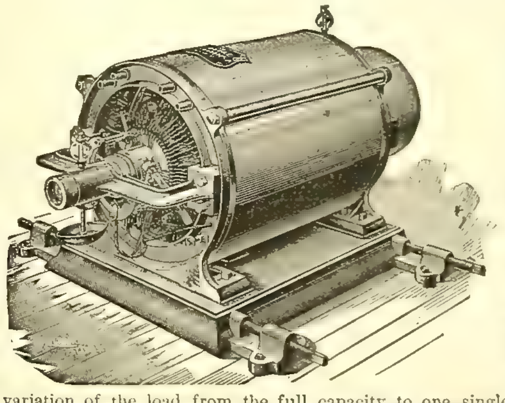

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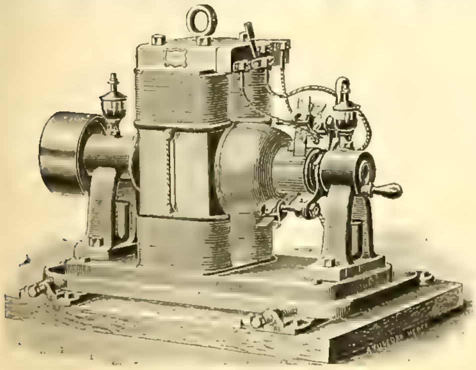

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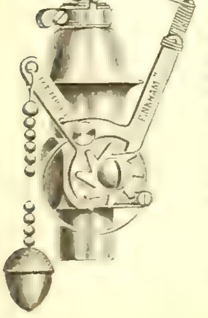

The Lift-Over Pendant Burner has a ratchet wheel governing a stop cock so arranged with a pawl and spring that one pull of the chain turns the wheel one notch forward, bringing one of the gasways of the gas cock in direct line with the burner gas way, thus turning on the gas, and at the same time through the Electrical connection lighting it. The next pull of the chain turns the ratchet wheel another notch, and the gas is turned off.

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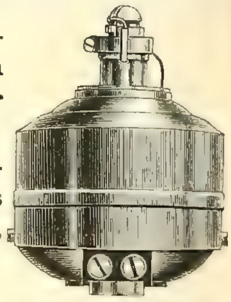

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Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

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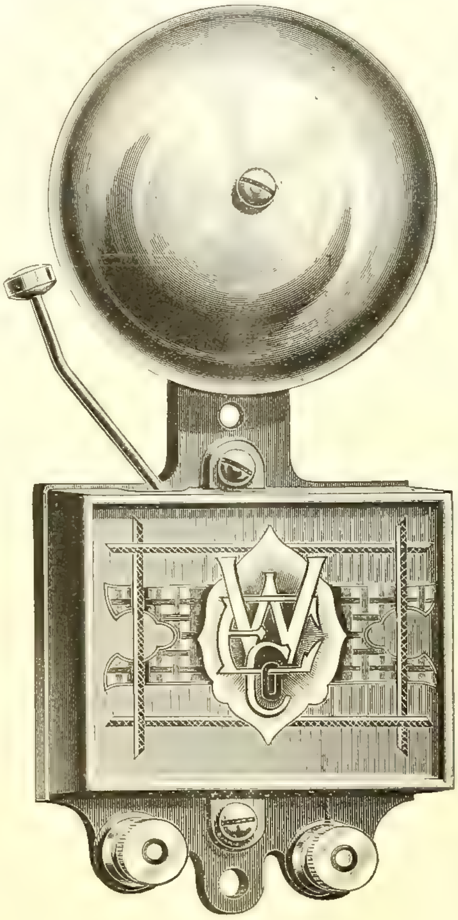

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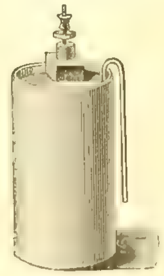

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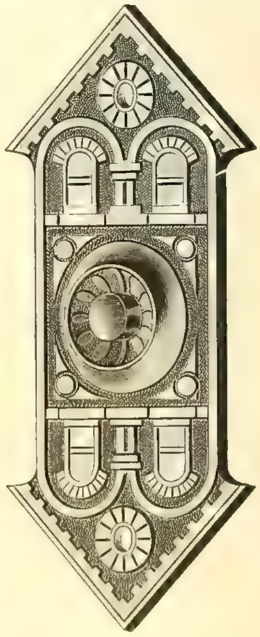

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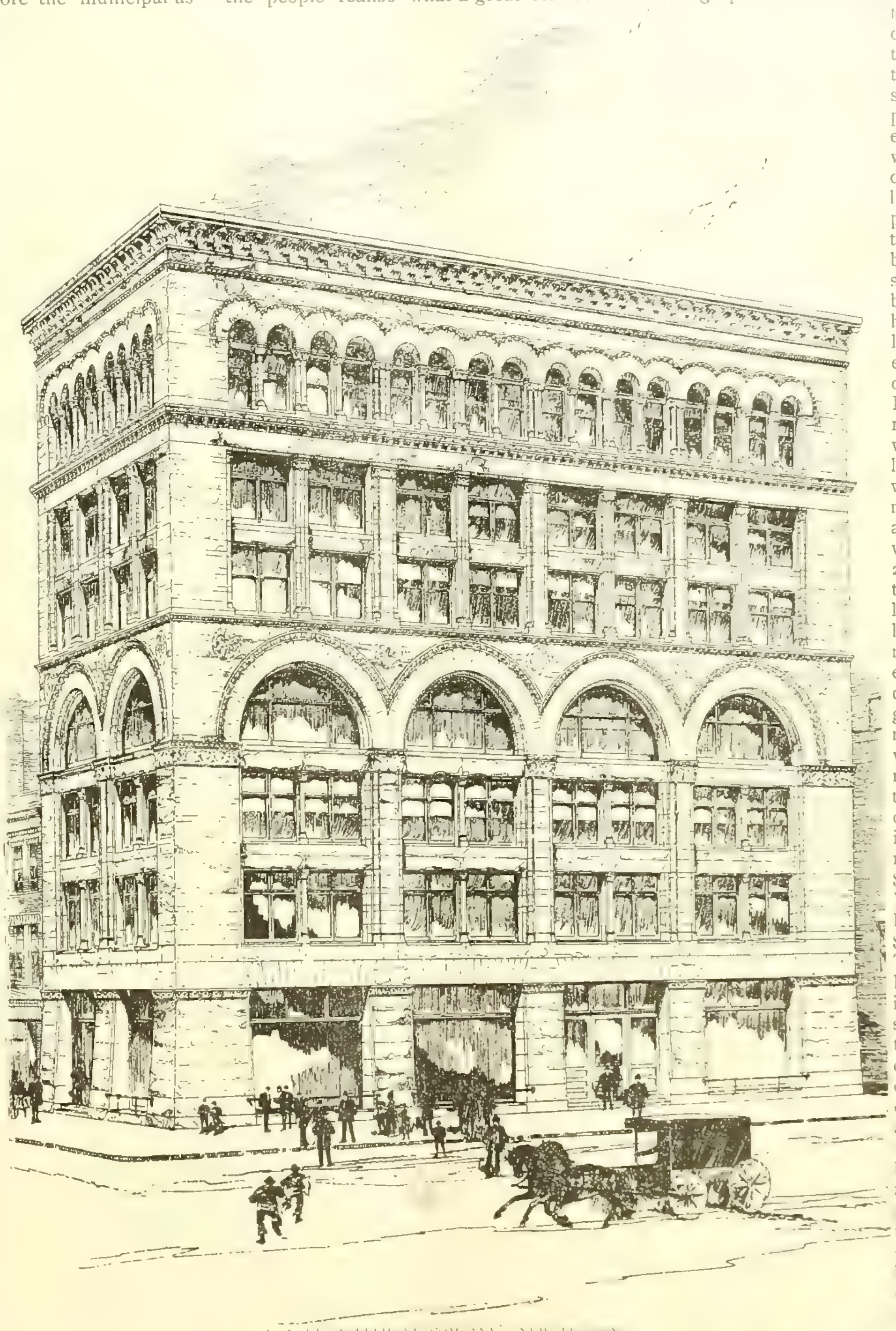
Vol. IV. CHICAGO, JANUARY 12, 1889. No. 2

St. Louis Telephone Company's New Building.

The Bell Telephone company of Missouri will soon commence the erection of a new building for its headquarters in St. Louis. It was decided to build just before the municipal assembly of St. Louis declared war against the company. The corporation maintained that it would be unable to continue business if the Supreme court affirmed the right of the city to reduce the schedule of rentals in accordance with the ordinance adopted by the assembly. Pending a settlement of the controversy, the building project was dropped. As soon as the Supreme court sustained the position of the company, and thus enabled it to continue its business, the directors determined to erect a structure which would be thoroughly equipped for telephone work. The plan for the new building was designed by Shepley, Rutan & Coolidge, architects. The appearance of the proposed building is shown in the accompanying cut. The building is to be located on the south-east corner of Tenth and Olive streets. The buildings there now will be torn down. The site is 50 feet on Olive street by 109 feet on Tenth street. The building is to be seven stories high, and of Kibey (Mass.) stone, rough dressed and fireproof throughout. It will present a very imposing and solid appearance. The cost will be about $125,000. The interior finish will be made to suit the tenant. The intention is to rent the first five stories and half of the sixth to one establishment. The executive offices of the telephone company will occupy the west half of the sixth floor, the elevator coming up from the rear on the Tenth street side. The seventh floor will be occupied exclusively by the telephone operating rooms. Work will be commenced early in the year, and pushed as rapidly as possible, though the completion of the building will probably require a year's time.



ST. LOUIS TELEPHONE COMPANY'S NEW BUILDING.

Residents of Rich Hill, Mo., are discussing a project of building an electric road in the village.

Chicago City Electric Lighting.

The success which attended the establishment of the city electric light plant in Chicago was naturally a source of gratification to Professor Barrett, the city electrician. The very fact that the people realize what a great service he has performed will necessitate a still greater expenditure of time and labor by him. Residents of Chicago are already clamoring for a more general distribution of the luxury. Petitions for electric lights are pouring in from all parts of the city, and in each case the petitioners lay stress upon the necessity of immediate action. [illegible] cently, he found that official endeavoring t[illegible] the solution of the problem of doing [illegible] work in one season. "[illegible] see," he said, looking up from his table, "everybody seems to want [illegible] course we cannot satisfy the demand. It will, I think, take about five [illegible] six years to extend the plant so as to light the entire city. Of course, what we have already done is merely to establish a foundation, by putting in the system on trunk streets. When we begin to fill in the cross streets we will reap the benefit of the work we have already accomplished; not before, however, for there is a pile of money invested there. It was a good investment, though. The work we have already accomplished, and the results we have to show for it now, are not unimportant. Out of 290 lamps which we have erected, 250 are so placed that they displace the gas lamps. Over 800 gas lamps were rendered unnecessary when we started, and the official in charge of that work, the gas inspector, has found many more lamps since whose presence is unnecessary. Therefore, the number of gas lamps displaced will be nearly, if not, 1,000, which means a reduction of $26,000 in our gas bills. We can run our electric lights at an expense of $60 a lamp per year. That would leave a balance of $10,000 a year in favor of the new system. Then look at the great advantage we derive from the superiority of electric light over gas. [illegible] invested, we will still [illegible] rent yearly cost. With the entire city [illegible] would be saved yearly [illegible]

Professor Barrett is at present [illegible] paring a report of the [illegible] system [illegible] the most [illegible]

ready accomplished. The foundation for the system is laid, and the central business portion of the city is covered. In speaking of this Professor Barrett said: "Take Madison street for example. There is so much light in that street from the stores and there are so many illuminated signs, that we were obliged to put in almost double the number of lights that we would otherwise need. We had to put two lamps on intersections, when it wouldn't be required in any other part of the city. There was another large item of expense in this district which we will not meet elsewhere to any extent. I mean the great cost of excavations, and replacing of roadways. You see the contractors have to give bonds for five years when they complete a street, and the city accepts it. Now, when we go to open that street they have to do the work, and also do the charging. But we have no redress. I could have the work done for 80 cents a running yard less than we paid them. But even under these circumstances I am well satisfied with the work, and the results we have attained." The river lamps, the first system introduced, cost $300 each, the last batch cost about $280, and the next, it is thought, will only cost $250 each. These figures include the cost of the entire outfit, including the power station outfit, etc. With each enlargement there is a corresponding reduction in the expenses.

New Alternating Transformer Systems

It is learned from an authoritative source that the Brush Electric company is about to put a new alternating 2,000 volt transformer system on the market. This system is said to resemble very much the alternating system of the Anglo-American Brush corporation of London, brought out last summer by its electrician, Mr. Mordey. To Mr. Mordey is also due the reconstruction of the Schuckert dynamo, the result being the improved Victoria, which is used exclusively for direct incandescent lighting by the Anglo-American Brush corporation. The Mordey alternating dynamo belongs to the type which has a stationary armature, with one internal field coil and large iron keepers revolving.

It is also learned that the Zipernowski-Deri system is soon to be introduced in the United States. Ganz & Co. of Budapest, the owners of the system, several years ago made an agreement with a leading American company, which is an advocate of the direct current incandescent system. This company, it is said, has never sold, and in fact never tried to sell, a Zipernowski-Deri outfit, and thus practically shut the system out of the country, besides breaking the spirit of its agreement. At least Ganz & Co., a firm of enormous capital, whose electrical department represents only a fraction of their business, seem to have come to this conclusion. They are now ready, it is asserted, to negotiate or have already reached an agreement with an American company for the purpose of introducing their system in the United States. As iron is cheap and wages are low in Hungary, they can probably compete successfully with American companies in spite of the protective tariff. As to the excellence of the Zipernowski-Deri system there is no doubt, and their patents were sustained in England against Gaulard & Gibbs.

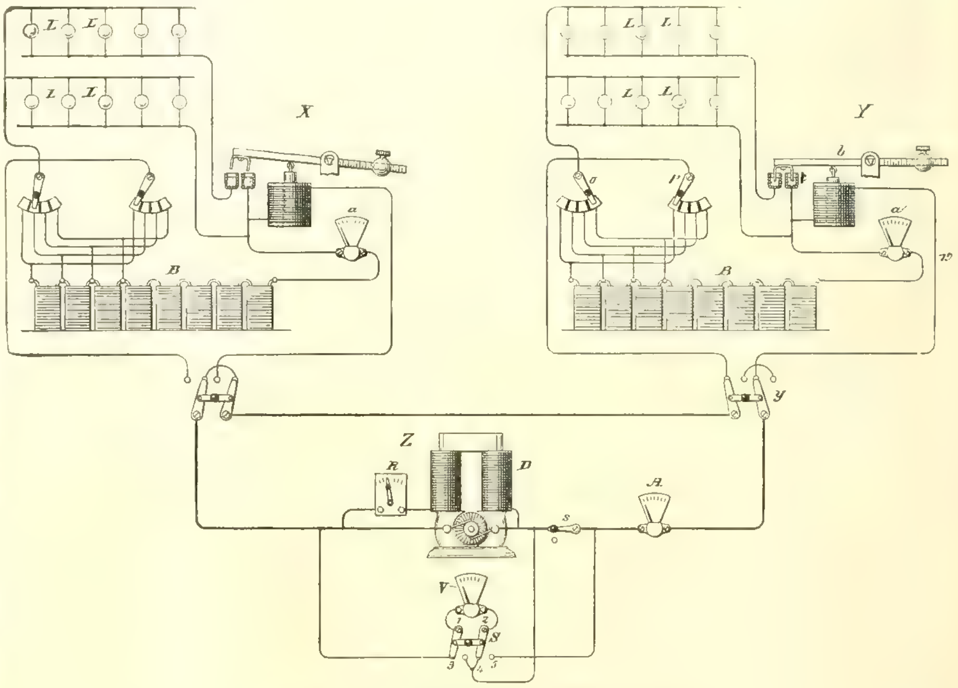
Chicago Electric Club.

A [illegible] Electric Club was [illegible] evening [illegible] presented his [illegible]rer, showing that the receipts of [illegible] expenses were [illegible]eater than this sum, but the deficit is [illegible]

Application of Accumulators to Central Station Lighting

Among the numerous uses of the storage battery one of the most important is its application to central station lighting. In the direct low-tension system accumulators are placed in multiple arc with the dynamos, and are so connected that surplus current not utilized in the lamp circuits may be stored for future use, thus serving to reinforce the dynamos under the strain of an excessive load, or to supply lamps during such hours as may present so light a load that it no longer pays to run the generating plant. Used in this way, accumulators, it is asserted, offer many advantages, which include reliability, steadying the e. m. f., increasing the life of the lamps, reducing the running hours of the dynamos, and diminishing the general wear and tear of the plant.

The general method of operating such a plant for long distance lighting, is as follows: The accumulators are located at the centers of supply, and the batteries at a number of these substations are charged in series by a current of sufficiently high tension to meet the requirements of the case, and with a current strength of from twenty-five to forty amperes, according to the type of cell used and the number of lamps to be supplied. This moderate current does not call for heavy conductors, number 4 B. & S. being sufficient in many cases.



APPLICATION OF ACCUMULATORS TO CENTRAL STATIONS.

The accumulators when charged are in some cases disconnected from the charging circuit, and all the sub-stations are connected in multiple arc to a common lamp circuit. In other cases each sub-station is provided with an independent lamp circuit, in which all the lamps are supplied by accumulators, but the most economical and the favorite method at present in use is that in which one-half of the lamps are maintained by the accumulators, while the remainder is supplied directly by the dynamos.

As an illustration of this system assume that each series of cells has a capacity of fifty lamps. The lamp circuit from each series would be connected to [illegible] lamps. The dynamo must be started shortly before the evening load comes on. At first the dynamo supplies the lamps in [illegible], charging the accumulators with the surplus current not utilized by the lamps. Later, [illegible] turned on, this surplus diminishes until the accumulators are no longer [illegible]. Then as the load increases [illegible] demand of the lamp circuit [illegible] the capacity of the dynamo, the accumulators [illegible] discharge, working in [illegible]. As the load begins [illegible] are reversed.

In [illegible] the dynamo [illegible] for [illegible] [illegible] charging the [illegible] [illegible] the [illegible]

work, and for those hours during which the dynamo is not in use. Each series is provided with means for regulating the terminal e. m. f., and for measuring and controlling the rate of charge and discharge. An important adjunct in this field is covered by a patent just assigned to the Electrical Accumulator company of New York, by Thomas P. Conant, of Chicago.

It was found in practice that if the dynamo failed during the hours of maximum lighting, or if the time of starting were for any reason delayed, it was possible for the accumulators in a half-direct system to be heavily overloaded, an accident productive of the most injurious results.

In order to obviate this and effectually guard the accumulators a number of devices have been introduced. In Mr. Conant's plan there is placed in the working circuit an automatic switch, operated by an adjustable electro-magnet which is located in circuit between the dynamo and battery. When the proper current is flowing from the dynamo the switch is closed and the section of the working circuit to be fed by the dynamos, connected; but the moment the current from the dynamo fails the switch opens and the dynamo section of the working circuit is disconnected, thus avoiding injury to the battery.

In this way the operating of the extra circuit is entirely automatic, and calls for no complications. Whenever the dynamo starts the extra circuits are thrown on, and when the dynamo stops they are thrown off. By a very simple adjustment the automatic switches can be so set as to close only when a certain strength of current has been attained.

This system, of course, requires that one-half of the lamps shall be out of use when the dynamo is not running. The objectionable feature of this may be entirely removed by carrying both the accumulators and extra circuits side by side, using a common return, and taking lamps alternately from each.

The accompanying cut, taken from the patent specification, illustrates Mr. Conant's invention. Z represents the charging station in which D is the dynamo provided with a rheostat R, ammeter A, voltmeter V S, and main switch s; X and Y represent two sub-stations, each provided with accumulators B, regulating switches *o p*, ammeter A, and automatic extra circuit cut-outs *b*, each series in conjunction with the dynamo supplies the lamp circuits L L; x and y are main switches by which either series may be thrown in or out of the charging circuit; y is shown with the charging current "on" and the extra circuit switch closed; x is shown with the charging circuit "off" and the extra circuit open.

The Electrical Accumulator company has installed a large number of central station plants on the general system described above, all of which are giving excellent results.

The Eiffel Tower.

One of the principal features of the exposition in Paris will be the Eiffel tower, which is now fast approaching completion. The structure was named after the constructing engineer, M. G. Eiffel, who has been assisted by Messrs. Naugier and Koechlin, engineers, and S. Sauvestre, architect. The accompanying cut gives a view of the tower looking from the Place du Trocadero. The building which is faintly outlined in the rear of the tower is the large machinery hall, which extends right across the Champ de Mars. The height of the tower, when completed, will be 984 feet.

Some idea of the enormous height of the Eiffel tower can be gained by comparison with the several of the highest towers and monuments in the world, as follows:

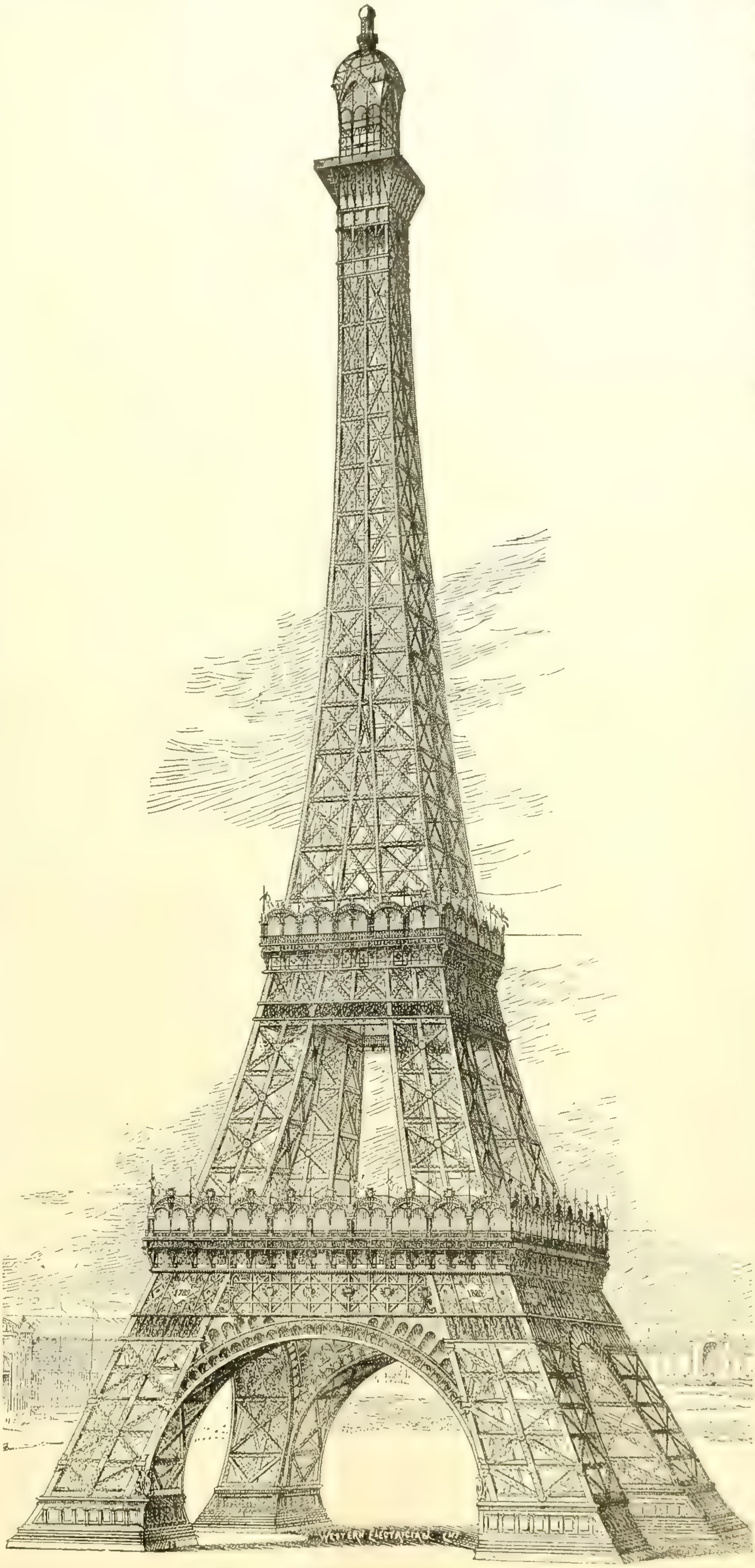
Eiffel Tower	984 feet
Washington Monument	550 feet
Cathedral of Cologne	511 feet
Great Pyramid, Egypt	450 feet
Statue of Liberty, New York	324 feet

The first story of the tower is 184 feet from the ground, the second 377 feet, the third 892 feet, and the fourth 971 feet. The structure is built entirely of iron. The four pillars on which it rests are 324 feet apart, measured from center to center; the pillars join in one tower between the second and third stories at a height of 584 feet, as shown in the cut. Four elevators, one in each of the four pillars, will carry passengers to the second story; these elevators follow the inclination of the pillars. Two elevators will carry sightseers from the second to the third story, a distance of 515 feet. These will rise vertically. Two electro motors will furnish the operating power. The speed of the elevators will be about a meter per second, and it will require seven minutes to complete the journey from the ground to the third story. Four spacious stairways will lead from the ground to the first floor.

The weight of the tower will be about 7,000 tons. It has been calculated that the resistance of the structure to the wind will be 300 kilograms per square meter. The strain of the winds in the greatest storms that have ever visited Paris has not exerted over half that pressure. The cost of the wonderful tower will aggregate about 4,500,000 francs. Of this amount 1,500,000 francs will be paid out of the exposition fund, and the balance will be furnished by the Messrs. Eiffel, who, after enjoying the income derived from the tower for a period of twenty-five years, will deed it to the city of Paris.

The first form of the tower was designed by Bourdais and Sibillot, who proposed to build the structure of stone and locate it on the elevation of the Place du Trocadero, and utilize the structure for the illumination of the entire city of Paris. It was estimated that the lighting apparatus would consist of 100 electric lamps, put up in a circle of 12 meters diameter; each lamp to be of 20,000 carcels, or 190,000 candle power: [illegible]

[illegible] for illuminat[illegible] of an electric lighting [illegible] pressed [illegible] sufficient [illegible] weather [illegible] towers, suitably located, with an illuminating power of 50,000,000 candle power each, would [illegible]bly light the whole city of Paris if the atmosphere were clear. In foggy weather the total of candle power necessary could be represented by a number of about 72 figures. Dr. Hugo Kruess calculates it at $\frac{.287}{(62)^{n}}$ candle power.



THE EIFFEL TOWER.

An Electrical Hoax.

The English electrical papers are enjoying hugely a joke at the expense of the editor of a provincial journal. The latter received a communication detailing at considerable length a process of making incandescent lamp filaments from cabbage leaves. The writer of the letter employed so much technical verbiage that the editor was led astray. He was completely taken in. He double leaded the communication and put a startling head-line over it, and now the papers unceasingly joke at his mistake.

Chicago North Side Cable System.

It has been clearly demonstrated that the north side cable system in Chicago cannot be depended on; that when most needed it invariably fails. This has caused the residents of that portion of the city no end of annoyance, and now it appears an animated fight against the present system will be made. Corporation-counsel Green, who was consulted by taxpayers, is quoted as saying:

"The city has power to compel the company to furnish adequate service under the provisions of its ordinance. The proper way to proceed would be for the city council to order an investigation and appoint a committee for the purpose."

"Do you think these everlasting stoppages, breakages and other accidents could be construed into 'adequate service'?" was asked.

"That would be a matter for the courts to decide. It seems to me that either the system [illegible]

or the machinery must be defective. In either case they should be compelled to put the matter right. There is something radically defective."

Corporation-Counsel Green is right. "There is something radically defective"—the cable system. The more experience the residents of North Chicago have with it the more they realize the force of the statement of Judge Green.

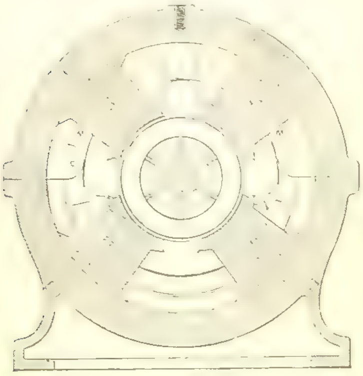
The Helvetia Dynamo.

Messrs. Alioth & Co., of Basle, are now introducing a new type of dynamo, particulars of which, by the courtesy of the firm, we are able to lay before our readers, says *Industries* of London. The dynamo is interesting, as a type which in England is very little known, viz., that of a multipolar machine with drum wound armature. A few machines of this character have been built by English makers, but the peculiar winding which we find in the Helvetia dynamo is, we believe, new to this country. As will be seen from the sectional views, Figs. 1 and 2, the frame of the machine consists of a heavy cast iron yoke ring, the lower half of which forms one casting with the bed plate and the two standards which support the shaft. The armature core consists of wrought iron disks, insulated with paper and mounted on a gun metal frame, which is so arranged as to allow air to pass freely through. Ventilation is also provided by spaces which are left between adjacent armature conductors, so that air may pass not only longitudinally through the core, but also radially outward, so as to cool the core plates and the winding. The inside of the yoke ring is turned, and into it are fitted four radial magnet cores of somewhat tapering shape, the inner section being 16½ inches long by 7 inches wide. The armature core is 19½ inches long and 14 inches in diameter, and about 2¼ inches deep. The current is taken off by two sets of brushes only, which are supported by the ring R. This ring is provided with circular slots sliding over studs, so as to allow a certain angular adjustment, which is effected by a hand wheel and worm gearing into a worm segment on the ring. The winding of the armature consists of coils [illegible] quarter of the circum[illegible] separately on a wooden mould, and afterward laid over the core. The [illegible] commutator strips [illegible]

[illegible] the leading [illegible] same size, one [illegible] glow lamps and the other for [illegible]

[illegible]

In the glow lamp machine the connections of the armature conductors are such that the current divides into four branches, and each conductor has only to carry one-fourth of the total current, while in the arc lamp machine the conductors are coupled in series, so that the current only divides into two branches. This will be more clearly understood from the diagram of connections, Figs. 3 and 4, and from the annexed table, which shows the manner in which the current divides between the various circuits. The diagrams are constructed for an armature having only forty conductors on the outer circumference, as it would have confused the figure had a greater number been shown. The figures written at the circumference correspond with the number of separate coils laid on; thus the first coil is indicated by the numbers 1 and (1); the second coil by the numbers 2 and (2); and so on. The front connections are shown in full lines, and the back connections in dotted lines; and the active part of the conductor—viz., that which lies parallel to the axis on the outer circumference of the drum—is shown by the radial lines joining the inner and outer dotted circles. The direction of the currents is indicated by arrows, and the following small tables will serve to show the way in which the current flows through the armature when the brushes are in the positions indicated in our diagrams.



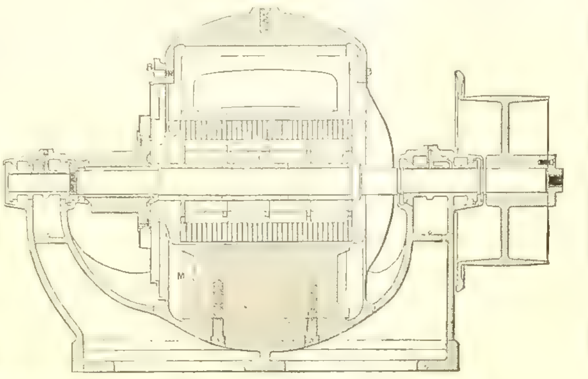
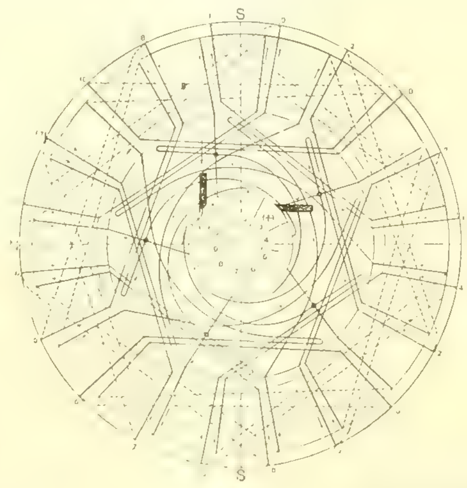


FIG. 1 THE HELVETIA DYNAMO. FIG. 2.



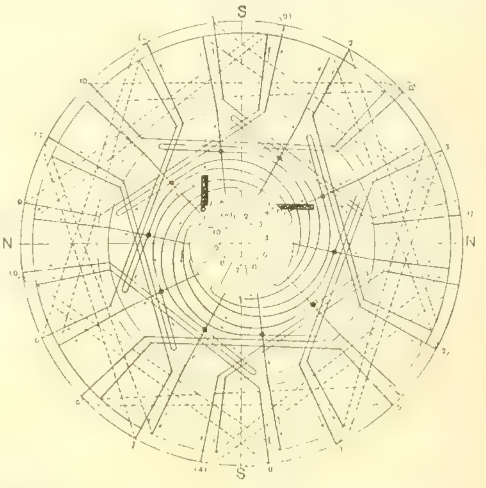


FIG. 3. THE HELVETIA DYNAMO. FIG. 4.

In the glow lamp machine.

From negative brush to [illegible] To positive brush.

In the arc lamp machine.

From [illegible] To positive brush.

Electric Railway at Des Moines

[illegible] railway recently [illegible] Houston company [illegible] and is now work[illegible] the people of that [illegible] the slow going horse [illegible] recently made [illegible] electrical system could surmount such obstacles as sharp curves, steep [illegible]

[illegible] considered one of the best appointed and most thoroughly equipped roads in this country. Power is supplied by two 40-horse power engines. The plant is an overhead system, and each car is supplied with a 10-horse power motor. The cars are handsome coaches, lighted by electricity, and elaborately furnished. The people of Des Moines went wild over the outfit, and the whole town witnessed the trial trip. The occasion was one that will long be remembered by residents of that city and by the Thomson-Houston company that constructed the plant.

The enthusiasm of the people of Des Moines may be surmised from the following statement of the *Iowa State Register*, in its account of the trial trip: "While speeding across the bridge the passengers of the luxurious and sumptuously furnished electric car caught sight of a horse car plodding across Walnut street bridge, and there was an outburst of loud cheers for triumphant electricity."

Consolidation of Edison Companies.

In the WESTERN ELECTRICIAN of December 8th was published an item to the effect that an important move was in progress by the Edison Electric Light company. The item stated that a large amount of new capital had been secured for the Edison company, which was to be used in extending their manufacturing business and installing new central stations.

This piece of advance news was published exclusively by the WESTERN ELECTRICIAN, and has since been extensively copied by the press. The project has now materialized, as will be seen from the following from a New York paper:

One of the biggest companies ever organized under the laws of New Jersey was incorporated in the Essex county clerk's office on Thursday. It is to be known as the Edison General Electric company. The capital stock is $12,000,000, of which $1,000,000 has been paid in. The stock is divided into 120,000 shares at $100 each. The works are to be in West Orange, with branch offices in all the leading cities. The incorporators, who each hold 200 shares, are Edward H. Johnson of Greenwich, Conn.; Samuel Insull, Schenectady; Francis R. Upton, Orange; Charles Batchelor, New York, and Alfred O. Tate, West Orange. The advisability of uniting the Edison manufacturing companies has long been considered, and this seems to be the consummation of the scheme. The officers of the Edison company of this city have been extremely reticent about the matter. The several plants can be operated at less expense under a single management, and the work more aggressively carried forward.

This verifies the statement which we published five weeks ago. The installing of central stations and the handling of the large contracts which are common in the electric lighting business require an enormous capital, and the Edison General Electric company is now abundantly supplied in this respect. The consolidation of the different companies will enable the Edison people to concentrate more advantageously their efforts and an aggressive policy may be looked for. The Edison Electric Light company, the Edison Machine works, the Edison United Manufacturing company and the Edison Lamp company are the principal companies which, taken together, make up the consolidation. As we understand it, $1,000,000 in cash have been put into the treasury of the Edison General Electric company, besides the turning over of all the business and properties of the different companies included in the combination.

Magnetism by Electric Discharges.

BY PROF. H. S. CARHART.

The experiments of Prof Oliver Lodge on Leyden jar discharges, and the discussion of the relation of these experiments to lightning rods, at the late meeting of the British Association, have drawn attention anew to the lightning rod question. The remarkable experiments of Prof. Lodge are explained by self-induction, arising largely from the oscillatory character of the discharge. Experiment leaves no doubt that a Leyden jar discharge is often and generally oscillatory. If lightning discharges are also oscillatory, then the conclusions derived from a study of Leyden jar discharges may fairly be applied to them.

Objection has been made to the inferences drawn from laboratory experiments, on the ground that it is not known that lightning is oscillatory; in fact, that the magnetization of needles by lightning goes to show that it is not oscillatory—swinging back and forth like a mass of water in a long trough. Precisely such currents —alternating and slowly decreasing in intensity —have been found to effect complete demagnetization.

It is known, however, that magnetic effects follow from the flow of an oscillatory discharge round a steel needle. I have examined many such with respect to the penetration of the magnetism and its lateral distribution. In many cases at least, and always under certain circumstances, a thin external shell is magnetized in an inverse sense to the deeper lying layers of the magnet. This outer portion may have its magnetism reversed without affecting the inner portions, and the resulting magnetic strength is equal to the difference due to the magnetism of opposite signs on the same end of the magnet. This peculiar distribution of magnetism I have ascertained by removing with acid successive portions from the outside of small rods magnetized by electric discharges, and determining at each step the weight and strength of pole or magnetic moment of the magnet.

The process of immersion in acid, cleaning and drying, weighing and determining magnetic moment, was continued till scarcely a trace of magnetism remained. The results can be exhibited most graphically by platting magnetic moments as ordinates, and decreasing weights as abscissæ. Fig. 2 exhibits the results with a magnet 6 centimeters long, 1.8 millimeters in diameter, and weighing 1.21 grams. The unit of weight taken in platting the curve is 50 mgs. The magnetic moments are quantities proportional to the deflections of the magnetometer. It will be seen that the magnetic moment at first increases to a maximum as the external shell is removed, and then decreases nearly with the weight. This demonstrates the reversal of magnetism superficially, while the deeper lying portions remain untouched; and this reversal itself is evidence of an oscillation in the discharge. The reversed magnetism is usually extended to about one-third the thickness of the magnetized shell after ten successive discharges of the Leyden jar through a circuit, the self induction of which was chiefly due to the magnetizing helix of twenty turns of wire insulated with gutta percha. The inner portion or core of the magnet was always found to be free from magnetism. Occasionally a slight reversal was found at the inner boundary of the magnetized portion of the rod.

In all cases the magnetic moment increases with successive discharges up to about ten. Beyond that the increase, if any, is very small. Fig. 1 shows the relation of magnetic moment to successive discharges through the magnetizing spiral. The two figures refer to the same magnet.

An oscillatory discharge is then capable of magnetizing steel, and lightning may still be oscillatory, and produce magnetic effects. There are perhaps two explanations—at least two suggestions—which may explain the magnetic effects produced by electric oscillations.

In the first place the mathematical theory, based on self-induction, shows that the maximum values of the intensity of the discharge decrease in geometrical progression, while the alternating currents employed to effect demagnetization decrease in something like arithmetical progression. It is not difficult to see that while the latter annul magnetism, the former may not.

Again Kirchhoff has shown that under certain conditions the time of one of the electric oscillations is much greater than the others. It is not unreasonable to suppose that the electromagnetic effect of this oscillation of long period may be far greater than the others. It is known that time is required to magnetize iron and steel, and Fig. 1 shows that the repetition of electro-magnetic impulses increases the total permanent magnetism.

We conclude then that oscillatory discharges do magnetize steel, generally, though not always, in opposite directions at different depths; and that the known differences between such discharges and alternating currents are sufficient to account for the difference in effect.

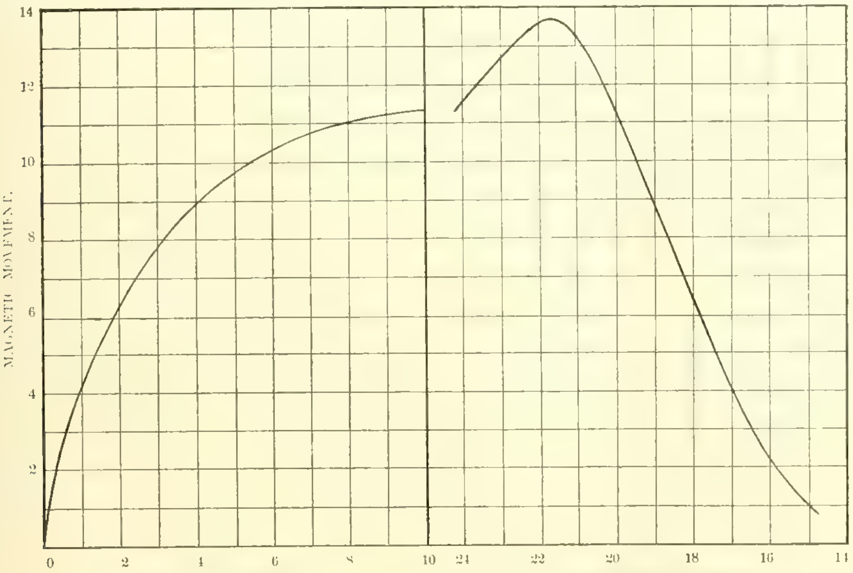


FIG. 1. DISCHARGES. FIG. 2. DECREASING WEIGHTS.

MAGNETISM BY ELECTRIC DISCHARGES.

National Electric Light Convention.

The executive committee of the National Electric Light association has completed arrangements for the convention which will be held in Chicago next month. The art rooms and restaurant of the Exposition building have been secured for the occasion. One of the art rooms will be utilized as a convention hall, and the others will be devoted to an exhibition of electrical manufactures and machinery. It is thought that 15,000 square feet of flooring will be occupied by electrical companies for displaying their goods; and if more space is needed it will be furnished by the committee. It is necessary, however, that manufacturers desiring space notify B. E. Sunny, chairman of the executive committee, immediately, in order that [illegible] will be [illegible] convention and exhibition. [illegible] tion.

The directors of the Exposition company have [illegible] of holding a general electrical exposition in the near future, and have consulted the executive committee of the national association on the subject. It is proposed to hold [illegible] for a period of six weeks, and make it the largest electrical display ever held in this country. The matter will undoubtedly be discussed at the approaching convention.

Journalistic.

Electric Power has appeared in New York. The new monthly presents a bright and handsome appearance, and as it does not pretend to cover the earth, but prefers to perform a few things well, it has a good show for success. It is well arranged, and ably edited. Ralph W. Pope, so well known from his connection with the American Institute of Electrical Engineers, is at the head of the new enterprise, which has our best wishes for its success.

We congratulate Messrs. Stump and Martin of the New York *Electrical World* on the fact that they have become stockholders and officers of the new company which will hereafter conduct that journal. They deserve this reward for the years of faithful and intelligent service which they have given to the paper.

Journalistic?

The Standard Electric company of Louisville, Ky., have begun the publication of a monthly catalogue as an aid to their business. It is called *The Electric Current*, and, we are sorry to say, masquerades as an electrical newspaper, its *ostensible* publishers being the Electric Current company. But as its real publishers are an electrical supply house, it must excuse the electrical public for having already consigned it to the catalogue class. This sort of business cannot be palmed off as journalism upon electrical people. Complete independence and freedom from all entangling alliances are the only conditions on which the electrical fraternity will extend its support to its newspapers. It is too discriminating and intelligent a constituency to be deceived by so transparent a ruse, and will not hesitate to stamp this venture with its emphatic disapproval

There is another pamphlet which has begun its existence under similar conditions. It is called the *Electro-Mechanic*, and sees the light in Kansas City at irregular intervals. It was started by the Kansas City agent of an eastern electrical manufacturing concern. We understand that this sheet now claims to have severed its connection with the manufacturing company. In that case we wish the undertaking all the success to which its merits entitle it!

We have been accused of [illegible] these sheets. We trust we have now cleared ourselves of this charge. But we must still decline to recognize the advertising pamphlets of supply houses as newspapers, [illegible] through with in getting them out as journalism.

An agent of the Postal Telegraph [illegible] asked business men of Oshkosh, Wis., [illegible] scrip to encourage the [illegible] through that city. The [illegible] scrip in services [illegible]. The scheme meets [illegible] of that place, as it [illegible] while the company [illegible] this advancement, which will be not only a working capital, but a guarantee [illegible] of Oshkosh think they [illegible] reduced rates, which [illegible].

Western Electrician.

EVERY SATURDAY.

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No. 6 Lakeside Building, - - CHICAGO.

W. A. KREIDLER, - - - Editor and Publisher.
J. W. DICKERSON, - - - } Associate Editors.
J. B. O'HARA, - - - }
A. C. BURROUGHS, JR., - - - Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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[illegible] to official returns seventy-four new electric light works were established in Tennessee during the last year.

In the New York letter this week a synopsis is given of the annual report of the Board of Electrical Control. Although the conduit system has been considerably extended, it appears that there are more miles of overhead circuits in the metropolis than there were a year ago.

NOT the least interesting feature of the Paris [illegible] will be the Eiffel Tower, of which a [illegible] It is a magnifi[illegible] [illegible] height and extreme[illegible] [illegible] proportions. The engraving [illegible] sent to the [illegible] Paris, and it gives, [illegible] appeared.

[illegible] ing the question with [illegible] derground system in [illegible] failure. [illegible]

Mr. Sunny, president of the Arc Light & Power company, that the underground system was working satisfactorily in Chicago, and it is curious that the news has not reached Milwaukee.

THE new year had scarcely commenced before New York city furnished a candidate for death under the new law providing for electrical executions. Just who the candidate is has not yet been determined by the police. The murdered man was Michael Crowe, and seven men have been arrested on the charge of causing his death, but as yet the officers of the law have been unable to fasten the crime upon any individual.

A CUT of the new building to be erected by the Bell Telephone company in St. Louis appears in this issue. The immediate erection of the structure is a consequence of the recent important decision of the Missouri Supreme court, which denied the right of the St. Louis Municipal Assembly to regulate telephone charges. Had the decision been adverse to the company the building project would have been indefinitely postponed.

COMMENTING on the action of the New York aldermen in granting the franchise for the electric railway in the metropolis, the New York *Sun* says: "We must first thank the aldermen for giving us the electric motor. They seemed averse to giving it at first, but it came with Christmas. We must next thank the motor itself for being the means of introducing a new and improved rail. That is one of the most glaring absentees and most imperative requirements of New York city."

THE executive committee of the National Electric Light association has leased a portion of the Exposition building in Chicago for the February convention. The sessions will be held in one of the halls, and another will be devoted to an electrical exhibition. There is every reason to believe that the exhibits will form a most interesting feature of the convention. A large number of manufacturers have signified their intention to be represented in the exhibition, and letters received by Chairman Sunny from all parts of the country indicate the greatest interest in this feature of the meeting. Those who desire to send exhibits should communicate at once with Mr. Sunny.

IN a recent issue of the WESTERN ELECTRICIAN an illustrated article appeared descriptive of the electric lights at Suakim and the extension of the African cables. Since the publication of the article the electricians of two of the British men-of-war have extended considerably the electric light plants on Quarantine Island. An illustration of the excellent character of the African cable service is found in the fact that the first telegram announcing the recent victory of the British troops at Suakim was received in London twenty minutes after the conclusion of the battle. The second dispatch giving details reached its destination thirty minutes after the operator commenced to send the message.

PROF. H. S. CARHART'S interesting article on "Magnetism by electric discharges" appears in this issue. He takes as his text Prof. Lodge's Leyden jar experiments. It has been demonstrated, he says, that discharges from the Leyden jar are oscillatory, and if the same statement applies to lightning, the conclusions derived from the study of the former phenomena may fairly be applied to the latter. Several interesting experiments are described. In concluding the article, Prof. Carhart says: "We conclude then that oscillatory discharges do magnetize steel generally, though not always in opposite directions at different depths, and that the known differences between such discharges and alternating currents are sufficient to account for the difference noticed."

I[illegible] appears in this issue, Prof. Barrett, city electrician of Chicago, em[illegible] of the new city electric [illegible] appeal to every city council in the country. He lays stress on the economy of the system. The 1,000 gas lamps which the system has displaced cost the city $26,000 per annum. To maintain the electric lights in the district formerly lighted by gas will not cost over $15,000 annually. On the assumption that the city pays 4 per cent. on the money invested in the plant, the saving to the municipality by the operation of the electric light system will be almost $9,000 yearly. The streets are lighted, too, as they never have been lighted before, and the service is far more satisfactory. It is not surprising that the electrical department of the city is overwhelmed by petitions for the extension of the service. When Chicago is lighted by electricity in accordance with the comprehensive plan of the city electrician, the annual saving will be, he estimates, a quarter of a million dollars.

THE telephone controversy which has proved such a vexatious problem in Chicago has at last been adjusted by the city council. After months of discussion the aldermen have adopted an ordinance which, in the main, is satisfactory to the telephone company and to a large majority of the council. By the terms of the ordinance the company will pay to the city 3 per cent. of its gross earnings in addition to furnishing free or at a nominal price a large number of instruments for the use of the city departments. It gained the ordinance without making any concessions so far as subscribers' rentals are concerned, and this was the vital question with the company. In giving the franchise the city gives up no right which it may acquire for the regulation of the rentals. The duration of the ordinance is twenty years, but if within that time the city obtains and exercises the right to reduce telephone charges the 3 per cent. payment is to cease. The adjustment of the controversy seems to give general satisfaction, even to those who think the city should make a persistent effort to obtain from the assembly the requisite authority to enable it to reduce charges. Such persons consider the measure excellent as a temporary expedient. The city will receive about $30,000 annually from the 3 per cent. tax. The sum, it is understood, is to be devoted to the extension of the electric light system of Chicago, and on that account the measure will probably meet with general favor.

THE electrical process of refining sugar turns out to be a swindle of gigantic proportions. The officers of the company admit that they were deceived by the alleged inventor and his accomplices, and that they and their friends have sunk all the money they put into the scheme. Professor Friend, about four years ago, claimed he had discovered a process of refining crude sugar by the aid of electricity. He asserted that his process was simple and extremely cheap. A company was formed to put the invention on the market. The professor refused to disclose the secret, but agreed to write out the details of the process, and deposit the description in a vault to be opened in case of his death. Exhibitions of the process were given to demonstrate its efficiency, and the experts who were present publicly declared their amazement over the results. They were simply deceived. Refined sugar had been brought to the exhibition room and substituted for crude sugar. Last winter Professor Friend died, and the knowledge of the secret remained with his wife. She kept up the deception until last week, it is asserted, until the officers of the company discovered the fraud. About $1,000,000, it is said, was sunk in the scheme before the bubble burst. Most of the money came from England, where there was considerable speculation in the stock.

It is said that in 1882 Friend turned up in Chicago and claimed to be the discoverer of a method of crystallizing grape sugar, so that it could not be detected from that made from the cane. Friend was able to find some Chicagoans who took a little stock in a company he started. But it was not long before they became suspicious, for he promised much and did nothing, and at last they became convinced that he was a fraud. He disappeared, and as his victims did not lose much, they took little pains to follow him.

Telephone Controversy in Chicago.

The telephone controversy has come to an end in Chicago, and the subject will not continue to be a source of bitter dispute in the city council. The Chicago Telephone company has secured a franchise giving it the right to operate in the city, without being subject to continual threats of litigation and interference with its business. Looking at the matter in this light the result of the controversy is a substantial victory for the corporation. The company pays as consideration for the franchise a sum greater than it at first proposed. The matter has been pending a long time, and it is a satisfaction to know that the difficulties have been finally adjusted.

A brief resume of the progress of the controversy during the last few months may not be without interest. In June last the aldermen decided to follow the example of the St. Louis aldermen if it were found that the right to regulate telephone rates could be exercised by the council. The legal department of the city was asked to investigate the question. In July an ordinance was presented, reducing the rentals to $75 per year. The measure was referred, and died in the committee room. During the next few weeks the council consumed considerable time in discussing the question, and the debates grew at times decidedly acrimonious. On October 8th two ordinances were presented, the first providing that telephone rates should be so reduced that $95 should be the rental for the first year and $85 for each succeeding year, or $75 on three years' contracts; the second ordinance, which was favored by the company, contained the provision that 2½ per cent. of the gross income of the company should be paid into the city treasury as consideration for a franchise. These measures were referred to the finance committee, which held meetings to consider them for weeks. About the time that the committee had decided to favor the ordinance which reduced the rates, Corporation-counsel Green gave it as his opinion that the aldermen had no right to regulate rates. The committee then asked the company if it would accept the ordinance even if the council did not possess the power to enforce it. A negative answer was returned, and the company offered as its best proposition to give 2½ per cent. of its gross income as consideration for a franchise. The druggists' association and the Telephone Subscribers' league protested against the acceptance of this proposition. Then came the St. Louis decision, which deprived those who favored action looking toward the reduction of rates, of their last hope.

When the matter was called up in the council January 4th, the friends and opponents were present in large numbers. It was evident that the settlement of the controversy was the all-important topic of the evening. The majority report of the finance committee was presented and adopted. This report recommended the adoption of the company's ordinance. It leaves the question of charges open, except that they shall not exceed those now maintained. It proposes to give the city 3 per cent. of its gross receipts, furnish free the telephones used by the city departments, and furnish for $5 each the instruments in use by the patrol and fire-alarm systems. This report received the support of 26 aldermen, while 19 opposed its passage. The result of the controversy pleased a vast majority of those present, and conservative business men generally favored an immediate settlement. By the terms of the ordinance the company will pay into the city treasury annually about $30,000, and the city will have practically a free telephone service.

This ordinance was not adopted without incident. After several speeches in favor of the measure had been made, Alderman Rix characterized the company's offer to pay 3 per cent. of its gross earnings as a mere bribe to the city. Alderman Hamline said the telephone monopoly would have to accept such an ordinance as the council would consent to give. It was a matter for compromise. The city was in a position to drive a hard bargain. The telephone company's offer last year of $5 per telephone was better than the offer of 2½ per cent. made this year. He thought the city would sell itself cheaply for so small a price. The company could stand a reduction of $85 for each telephone. That would give a percentage of gain to the monopoly of 30 per cent. In reply to the argument that 500 persons required telephones and could not get them, why did they not get them? Because it was alleged that the company had no right to extend its plant. Then the company could not have the right to operate the existing plant without further permission of the city. This, then, was the position. The monopoly was in a hole, and the council proposed to help it out if the majority report were adopted.

Alderman Cullerton supported the majority petition. The druggists' committee and Telephone Subscribers' league, which had been so violent in their demand that the council should secure a reduction of rates, were humbugs. The leader of the druggists' association had admitted that he made a greater amount of money out of his telephone than the rental cost him.

The more important provisions of the ordinance are as follows:

Where the wires are laid underground the company shall, for the purpose of reaching and connecting their subscribers and branch offices, have the privilege of bringing the said wires, conductors, and cables to the surface within every four blocks and attaching the same to houses and carrying them over roofs, provided the consent is first obtained from the owner to whose property they propose to attach said wires, conductors and cables, and said wires shall be kept at least twelve feet above the surface of the roofs, except in such buildings as the wires are to enter, and said company may in so doing cross streets, alleys, and city property with wires grouped in cables. * * * It shall, through its president or secretary, file with the city controller, the first day of January and July of each year, a statement of its gross receipts from the telephone business done within the city of Chicago for the six months next preceding such statement, and the said company shall pay into the city treasury 3 per cent. on such gross receipts, and the company, during the term for which the ordinance is granted, shall not increase to its present or future subscribers the rates for telephone service now established. Also, that with the acceptance of the ordinance there shall be filed by the said company a schedule showing the rates charged for telephone service at the date of the passage of this ordinance within the limits of the city of Chicago.
* * * * * *

Nothing in this ordinance contained shall be construed or taken as preventing the city of Chicago, whenever it shall be authorized so to do, from passing an ordinance regulating the rates to be charged by telephone companies for the rental of telephones, or for the licensing of telephone companies, it being the intention of this ordinance that the city of Chicago shall in no way surrender any rights it may have, or may hereafter acquire, to license telephone companies or to regulate the prices to be charged for telephones. But if the city shall acquire the right to regulate rates and exercise the same, the payment of the 3 per cent. shall cease

There are provisions requiring the telephone companies not to enter into combination with similar corporations under penalty of forfeiting its charter; also reserving the right of the city to grant franchises to competing companies The duration of the ordinance is twenty years.

Train Lighting by Electricity.

The practicability of train lighting by electricity has been fully established, and there is no reason now why enterprising railroad managers should continue the use of oil or gas in this progressive age. The utility of electricity for this purpose has been so clearly demonstrated that it can no longer be classed as an experiment. The principal railroad companies in the country have been testing the numerous methods, and the several systems have been developed to a high state of perfection. Wherever electricity has been given a fair trial it has shown its superiority in train lighting as in all other kinds of illumination, and those who have had experience with the old and the new systems invariably refuse to return to the old method. Prominent among those interested in the development of electricity as a means of lighting trains is the Pullman Palace Car company. Two years ago this company became convinced that train lighting by electricity could be successfully accomplished, and began a series of experiments and trials for the purpose of ascertaining the best plan. In the course of their experiments the electricians employed made numerous discoveries, which have been applied in their present system. At present they have a system that is so far superior to the old method of illumination that persons accustomed to travel in Pullman cars would revolt should an attempt be made to return to the old method of oil lighting.

In order to ascertain the progress made by the Pullman company a representative of the [illegible] for the illumination. The [illegible] The dynamos are all classed as [illegible] volts and 80 amperes, and capable of [illegible] press their full capacity, however. They [illegible] wholly inclosed, iron clad, and therefore, there is little danger of accidents, such as cutting wire by the dropping of a sharp tool on them. Moreover, it is claimed there is little magnetic leakage and no danger of affecting the trainmen's watches. Alex. Thompson, electrician of the Santa Fe, says these dynamos perform their work admirably. The center of gravity of the machine being low, there is no danger of its shifting in its bed by reason of the vibration of the train. The system of winding in these machines prevents internal currents, and thus sparking is almost unknown. But it is in its capacity that this dynamo, he says, especially commends itself to him.

Storage batteries are used in connection with these machines. On the Santa Fe road 32 23-C cells are placed under each car. These are charged from the dynamos during the day. The greater number of lamps receive their current from the dynamo directly, and the balance take their supply from the accumulator. On a seven-car train on the Santa Fe road 192 cells are used. These are supplied by the Electrical Accumulator company of New York. The dynamo and the cells supply current for 126 lights. These are divided as follows: Chair car, fifteen; dining car, twenty-four; sleeper, twenty-six; first-class coach, sixteen; second-class coach, twelve; and the balance in the baggage car. A special system of wiring is used in these trains which renders the employment of numerous switches unnecessary—an arrangement, it is said, which saves $100 in fitting up each car. Mr. Thompson has invented an arrangement for coupling the wires of the several cars, which is both simple and effective.

The success of the new system of train lighting by electricity is apparent to all who visit the Dearborn street station, Chicago, when these trains arrive. The contrast between the brilliantly lighted palace cars and the dim flickering of oil lamps is indeed striking, and cannot fail to demonstrate the superiority of the electric method over all other systems of lighting.

Cleveland Electric Road.

Last week the East Cleveland Street railway [illegible] by the Sprague Electric Railway & Motor company [illegible] New York, was put into successful operation. The road is operated on the overhead system, with number 6 silicon bronze wire as a working conductor. The [illegible] this road consists of sixteen cars, equipped with [illegible] apparatus of the latest type. The power station is situated on Cedar avenue, and is one of the most [illegible] plants of its kind in the country, and [illegible] if it does not equal, the Sprague electric power [illegible] Boston. The size of the station is 93 by 125 feet. [illegible] generating apparatus at present includes ten [illegible] dynamos wound for 500 volts, and 40,000 watts [illegible] The power house is arranged for an easy [illegible] capacity when there is any addition to the [illegible] or extension of line, and the motive power [illegible] 1,500 horse power without changing the [illegible] machinery. The overhead system on this road is [illegible] light, and is remarkable for its neatness. [illegible] impossible to see any part of the [illegible] hardly seems possible that it can be [illegible] sion of nearly 250 horse power of [illegible] uted over so many miles of track [illegible] entire equipment of electric cars [illegible] working conductor is connected at [illegible] with the main conductor by short branch wires. [illegible] conductor is itself supplied at several [illegible] points by feeders which come from the [illegible] central station, and which maintain [illegible] line constant at all points of the road. [illegible] is made through the rails, and [illegible] ground circuit to the power station. [illegible] is electrically connected with the [illegible] at each 500 or 600 feet along the [illegible]

wires with large earth plates, insuring practically no difference of potential between the rails at any portion of the [illegible] December 29 was in every [illegible] motor cars, drawing a [illegible] the city terminus of [illegible] to East Cleveland. Upon the first car was Dr Everett, president of the road, accompanied by a large number of the directors of the company, members of the board of aldermen and other city officials, and [illegible] W. [illegible] the Cleveland agent of the Sprague Electric Railway & Motor company. The cars were operated entirely by the railway company's drivers, and none of the electrical experts present touched the switches. No attempt was made on the trip to show speed, but the distance was made in less than twelve minutes. On the return trip the [illegible] was made in ten minutes. The trial was perfectly satisfactory to the directors, who were well pleased with the easy motion of the car in starting, rounding curves, and in speeding The property owners and citizens living along the length of the line showed the greatest enthusiasm at the successful trip made by the electric cars, and greeted their appearance with cheers all along the line. On the return trip the car was raced by a number of gentlemen in carriages, but succeeded in distancing them [illegible]

Electric Road at Rochester, N. Y.

Work on the electrical railway between Rochester, N. Y., and Ontario Beach the principal summer resort of that section, has again been dropped, owing to a disagreement between the company and the trustees of the town of Greece, through which the proposed line will pass. It is hoped, however, to continue work in a few days. At a recent meeting of the company a committee was appointed to visit Boston and New York for the purpose of inspecting the motive power of electric railways in those cities, and gaining experience regarding the practical workings of the eastern systems. A representative of the company said: "We shall use a storage battery if we can find one that will do the work We want something practical, and don't ask for perfection." Commenting on this the Rochester *Morning Herald* says editorially: "In any event the substitution of electric motors for horses on street cars is a question of only a short time. It will not be many years, at the longest, before all the street cars in this and other cities will be run by electricity."

Lamp Lighting Schedule. — Moonlight System.

JANUARY.

Day of Month	Light	Extinguish.	Number of Hours.
	H. M.	H. M.	H. M.
1	5 10	6.20	13.10
2	5.10	6.20	13.10
3	5.50	6.20	12 30
4	7.00	6.20	11.20
5	8 20	6.20	10.00
6	9.20	6.20	9 00
7	10.20	6.20	8.00
8	11.20	6.20	7 00
9	12.20	6 20	6 00
10	1.20	6.20	5.00
11	2.20	6.20	4.00
12	3.10	6.20	3.10
13	4.10	6.20	2.10
14	[illegible]	6.20	1 20
15	No	light.	0.00
16	No	light.	0.00
17	No	light.	0.00
18	5.30	7.30	2 00
19	5.30	8 40	3 10
20	5.30	9.40	4.10
21	5 30	10.50	5.20
22	5.40	11.50	6.10
23	5.40	1 00	7.20
24	5.40	2 10	[illegible] 30
25	5.40	3.20	9 40
26	5.40	4.30	10.50
27	5 40	5.40	12.[illegible]
28	5.40	[illegible] 10	12 30
29	5 40	[illegible] 10	12 30
30	5.40	[illegible] 10	12.[illegible]
31	5 50	[illegible] 10	12.20
			224 [illegible]

[illegible]

Speed of Dynamos.

[illegible]

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan 5 —The Board of Electrical Control has scored a victory in the result of the attempt of the United States Illuminating company to secure an injunction against it to prevent its interference with the poles and wires of the latter. The application for a permanent injunction was denied by Judge Lawrence of the Supreme court, January 2d. Affidavits had been presented by both sides to support their respective positions. Among those submitted by the board was one by the city electrician of Chicago, showing that conduits for arc and incandescent circuits were successfully used in that city. Judge Lawrence held that, in view of the conflicting opinions of experts, he believed that the legislature was wise in giving the board full authority to act in the matter.

The judge says: "I am of the opinion that the whole equity of the plaintiff's case is met, denied and answered by the defendant's papers, and I therefore see no reason for interposing the strong arm of the court to arrest the progress of a great public work, the speedy conclusion of which is desirable for the safety and convenience of the people."

The Board of Electrical Control has made its second annual report to the governor, the previous reports having been made by the old Subway commission, which was practically the same body The total length of trench excavated in the city is 240,155 feet, and the total length of single duct for telegraph and telephone service is 2,287,880 feet, less 325,429 feet for distributing service and connections. Estimating the duct as having a capacity of eighty wires, the total mileage of wire provided for is 34,665. It is estimated that the conduits have a capacity for nearly 600 miles of wire, exclusive of the Edison system. The number of poles removed is given at 776, and 946 miles of wire have been taken down. The Metropolitan Telephone & Telegraph, the Western Union, the Brush and the Edison companies, and the city fire alarm telegraph have in all 4,453 miles of wire underground, but it is admitted that there are to-day more miles of wire overhead than existed a year ago. The board is of the opinion that where companies fail to avail themselves of the subways provided within a reasonable time, their poles and wires should be summarily removed from the streets.

At a meeting of the old board of aldermen January 2d, a little stir was made by a letter from Mayor Hewitt, explaining that he had signed the bill providing for the use of the Julien electric cars on Fourth avenue, under the stipulation that the railroad company would remove the old rails and put down a pattern which would be less of an obstruction in the streets The letter was criticised by some of the aldermen, who said it was written for the purpose of imposing on the public. No action was taken, however, regarding it.

The managers of the various horse railway companies do not take kindly to the proposition that they shall do away with the present T rail, as suggested by Mayor Hewitt. They say there are millions of dollars' worth of rails now in use, and the only fair plan would be to gradually substitute a different pattern, as the old ones required replacing. The Third Avenue company is willing to do almost anything, provided permission is given them to use the cable instead of horses, but President Lyon says the grooved rail proposed by the mayor will not be satisfactory to the patrons of the road, on account of the jolting to which they will be subjected. The present rail being on the same principle as that used by the steam railroads is, in his opinion, confirmatory of its excellent qualities. Mr. Lyon is not in favor of using electricity.

Simon Sterne, W. D Stewart James Talcott, Frank O. Herring and Jeremiah Fitzpatrick, the committee on telephones of the board of trade and transportation, will soon prepare a bill to be presented to the legislature. It will carry on the fight of the board against high telephone charges which has been going on for four years. It now appears [illegible] the bill will prescribe a maximum charge of about [illegible] a month in New York city without regard to the part of the city in which the telephone is used.

[illegible] annual report refers to the [illegible] of its regulation, [illegible] over navigable streams, [illegible] prescribing a pen[illegible] regulation established [illegible] August 7th, 1888 [illegible] of the pending by the [illegible] by the hot pipe [illegible] At the office [illegible] of the [illegible] pipe line [illegible] There [illegible] system and

prevent underground electrical conductors remaining permanently in good order so long as iron pipes are used for ducts. P.

Omaha, Neb.

OMAHA, Neb., Jan. 2.—The city's injunction proceedings against the Omaha Motor Railway company, the Omaha & Council Bluffs Railway & Bridge company, and the Thomson-Houston Electric Light company, to restrain them from erecting poles for railway purposes, came up for hearing in the District court. Counsel for defendants asked the court for an order directing the plaintiff to file proofs, and stated that the electric light company had been restrained on the theory that it was in collusion with the other defendants, and erecting poles for railway purposes. Under the order of the court the company could put up no more poles for its own use, therefore counsel wanted the question of collusion heard at once. Counsel for the city said that the case might be determined by discovering whether or not a railway could be maintained by appliances other than overhead wires. He said that a street railway in New York City was operated successfully by underground wires at a cost of $1.87 a day per car, and cited other cases. He held that the light company was putting up poles to be used jointly by it and the motor company. Defendants' counsel said he would not deny the fact, but would say that the proper course for the city was to enjoin the electric light company from using the poles. The city's counsel urged that it was the city's duty to compel these public corporations to adopt underground appliances. Defendant replied that it would be too expensive. He thought the present litigation had been instigated by other companies, and that the mayor had been roped into the present suit. The court said he thought Omaha could do without the motor railway for a week longer, and therefore he would continue the injunction for a week longer. It seems to be the general impression that the motor folks have arranged with the Thomson-Houston company for their present supply of power from the Eleventh street station.

President Smith, of the horse car company, on the same day threatened to have all the motor officers, Dr. Mercer in particular, arrested for proceeding with connection work on lower Douglas street. The district attorney was heard to say in the afternoon that Mr. Mercer and his colleagues were to be arrested for contempt of court in proceeding with the same work referred to by President Smith. The Omaha Motor company has put a force of men at work at the Eleventh street intersection of Douglas, where they made connection between the end of that line and the end of the horse railway track. The road, when this work will be finished, will have a double track on Douglas to Fourteenth street, which up to Eleventh street may be used jointly by both the Omaha motor and horse railway companies. The latter company has been anxious, it is claimed, to have the bridge motor cars run around its loop on Douglas, Eleventh, Farman and Ninth streets. It is stated that it offered to pull the motor trains around the loop with horses. The motor people, however, doubted the feasibility, and let the horse railway superintendent attach four horses to one of the trains which stood at Ninth and Douglas streets. The horses could scarcely move the train, which was then declared to weigh more than sixteen tons.

The first car heater was put into the bridge motor car last week. It comprises a stove fed with crude petroleum from a tank on the roof, and heating the car through pipes running under the seats. All cars on the bridge line will be heated by this system.

The first annual ball of the Omaha or A. D. Thurston division of railway telegraphers was given at Masonic hall last week.

Electric lights are burning brilliantly all over the business part of Holdrege, Neb. Only arc lights are burning, but soon over 300 incandescent lights will be started. G.

OMAHA, Jan 5. Judge Dundey has modified the injunction against the Thomson Houston company, regarding the erection of poles He says it may proceed with its works on any street not occupied by the motor railway, and stretch wires all over the town. Councilman Hascall made a speech at the last meeting of the council extolling the merits of the motor line as a home company, and introduced a resolution to the effect that the Omaha Motor Street Railroad company be allowed to do all things necessary to operate the motor railroad by electricity; that all opposition of the city of Omaha and its authorities to the erection of the necessary poles to operate the railway be withdrawn It was backed up by a petition signed by I. D. West and twenty eight other citizens.

Mr. Burnham moved an amendment that in placing poles or excavations should be made so as not to destroy or injure

curbing or sidewalk. This was accepted as part of the original motion, which was carried. The mayor was seen the next morning and asked what effect the council resolution would have upon the question. He said that it would have no effect whatever, as the matter was in court. Dr. Mercer was seen later and asked the question above referred to. He said that what the company would do depended upon the future. The resolution of the council was a kindly evidence of sympathy with the company, and expressive of the feelings of the people. The matter was before the courts, and while it was there no poles would be erected.

In the District court last week the injunction against the Motor Street Railway company, the Omaha & Council Bluffs Bridge company, and the Thomson-Houston Electric Light company, came up for hearing. Mr. Webster, attorney for the city, filed a dozen affidavits procured during his visit to the east, for the purpose of showing that electric railways could be operated by other means than overhead wires. The defendant companies asked the court to so modify the existing order as to allow the motor company to string its wires from Ninth to Thirteenth street and operate its road for that distance. If the court finally determine that the defendant should be enjoined they would take down their wires and cease operating their road. The modification applied for was strenuously opposed by Mr. Webster, who stated to the circuit court that Omaha had flourished up to the present without a motor line, and in his opinion disaster would not follow if she did not have this means of transportation for a couple of weeks yet. After the arguments had closed the judges held a consultation, and the court stated that no injury could be inflicted by so modifying the order as to exempt from its force that part of Douglas street between Ninth and Thirteenth streets; and upon that theory he would allow the motor company to string its wires along that thoroughfare for that distance, subject, however, to the final adjudication of the cause. The bridge company originally applied for permission to extend its wires, but, as it was asserted to be a foreign corporation, Dr. Mercer's motor, which has not yet put up any wires, took the job off its hands. The cause was set down for hearing January 10th.

John L. Webster, the city attorney, returned from New York last week, where he had been for the purpose of ascertaining whether street cars could be run successfully by electrical appliances without the use of poles and overhead wires, said to a reporter: "I was permitted to examine the Bentley-Knight conduit system with all its appliances, and the cars and machinery in process of construction. They are able to demonstrate to any candid observer that with their system as at present perfected there can exist no difficulty whatever in the operation of an electric road by an underground wire. I also gathered the proofs that the same system is adopted in the city of Boston in its business portion, and overhead wires are only permitted in the suburbs. The same is true in Allegheny City, where the overhead wire is used in the suburbs, but the car is detached therefrom and connected with the conduit system when it reaches the business portion of the city. I called upon William Brackin, the managing director of the Julien Traction company, and was permitted to gather valuable information regarding their cars, which were operated by the storage battery system. The cars are handled with as much ease, system and regularity as the ordinary horse cars, and can travel with a great deal more rapidity."

Mr. Woodworth, solicitor of the Western Union Telegraph company, was not at Leavenworth at the appointed time last month to ask Judge Brewer to grant the injunction to restrain the Union Pacific railway from taking possession of the wires Neither was Mr. Thurston, general attorney of the company, before Judge Brewer. The great telegraph suit is to come up at Washington, unless plans are changed. They will unite in asking the Government to come into the case. As a reason they will urge the Anderson act, in which the attorney-general was charged with the protection of the interests of the Government in subsidized railway lines. Anticipating the enforcement of this act, the Western Union asked the injunction to protect such of its lines as were used by the Union Pacific, and to prevent the Union Pacific from breaking its contract for the use of its lines by the Western Union.

Mr. Thurston's trip to Washington last week was to see Attorney-General Garland, to whom, immediately upon being served notice of the suit, he had sent a copy of the bill with a letter requesting the attorney-general to intervene in behalf of the government, as the question grew out of the act of Congress referred to. Mr. Thurston also notified the Postal Cable company of the same fact, and asked them to intervene if they desired. The hearing originally set was postponed at the instance of the Western Union to await the decision of the attorney-general. The three parties of the suit wish the government to interfere [illegible] feel that if it does the question will be settled [illegible]

At a meeting of the South Omaha Electric Light company a contract was entered into with George H. H[illegible] mond & Co., by which twenty-two 2,000 arc lights and necessary incandescent lights will be furnished for the [illegible] packing house. A new dynamo with a capacity of [illegible] lights has been ordered, and will be put in at once. M.

Indianapolis, Ind.

INDIANAPOLIS, Ind., Jan. 5.—The Union railway station electric lighting system has been extended so that the tunnel under the Union tracks at Illinois street is now lighted, a change which constitutes a decided improvement at that point.

The Brush Electric Light company has all their poles set and wire strung, and are now putting up arms to support the lamps at street intersections. The company will be ready in a few days to begin lighting streets in the territory assigned them by the city engineer. The contract calls for 100 lights at the start.

A curious story comes from Jeffersonville of a man who has become insane. His delusion is that the government is about to light the entire country by electricity, and has offered prizes to any one devising an arrangement whereby wires may be suspended. He spends his time in trying to make a wire hang in the air without supports.

A special from Terre Haute, Ind., says that the city has awarded the contract for street lighti g for three years to the electric light company, at present furnishing light for $70 per 2,000 candle power lamp per year. This is a saving of $4,000 over the former year's price, and is also $7,000 higher than gas company's bid for lighting the same territory. M.

Des Moines, Ia.

DES MOINES, Jan. 5.—The power house of the new electric railway is located on First street, between Walnut and Locust streets, where the two 40 horse power engines supply the power to generate the electricity necessary to propel the cars. The overhead wire is copper, three-eighths of an inch in diameter. It is suspended at a height of about 16 feet above the rails, all along the line; two poles, one on each side of the street, hold a cross wire, in the center of which is a porcelain insulator. The rails are the ordinary street car rail, and in order to make the conjunction absolute a copper wire connects the rails at the joints.

The motors used in the cars are of 10 horse power each, but they are capable of doing considerably more work. Either motor is alone sufficient to run the car, so that if one of them accidentally gets out of order or is lifted from the rails, the other one alone propels the car.

The Belt Line Railroad company is not only rapid in its transit, but the management is rapid in executing its forward movements. Dr. E. T. Likes, who has sole charge of the line, saw an opportunity of obtaining more equipment without the delay of placing orders for building same, and went to Topeka recent y and purchased two noiseless motors and four cars; they will be shipped here at once. Dr Likes gave these reasons why the Topeka company had abandoned the use of steam for electricity: "It is not for the reason that steam motors are a failure or a nuisance in Topeka, but the company's line which has operated these motors runs through a great many of the business streets, and has sixty-three curves to traverse. The motors were compelled to travel slowly, and yet to get around these curves had to carry a full head of steam all the time, which consumed more anthracite fuel than their receipts warranted —in other words, made the running expenses too heavy. With electricity the road is able to make better time, to run easier, and at a less expense." M.

Kansas City, Mo.

KANSAS CITY, Mo., Jan. 5.—The telephone company is progressing more rapidly with its repairs than was at first thought possible, and about 500 of the 1,000 telephones cut off by the storm of Christmas night are now in order. The Grand avenue circuit is not yet in order, but the poles and material have been received, and it is expected that the entire system will be in order by the end of the week. On the large circuits the company is stretching the wires in cables instead of separate wires, and this will render breaks less frequent in the future.

The Pacific Mutual & Postal Telegraph company have made arrangements for extending their lines, so as to take in about all the territory in the United States not already occupied. The most important feature is the purchase of the Chicago, St. Paul & Kansas City Railway telegraph lines, better known as the Stickney system. Hon. T. F. Clohesy, manager of the company's business in this city, said that it had purchased the Stickney wires, and had already begun operating them. This purchase gives the [illegible]

[illegible] ns, taking in all the principal [illegible]

[illegible] done.

The meeting of physicians and druggists [illegible] the dissatisfaction over telephone rates [illegible] Midland hotel last Saturday evening [illegible] favor of agitating a popular movement and endeavoring to get all professional men and business houses to take out their telephones, but most of those present discouraged this idea. All declared that they believed the rates to be not only excessive, but unequal, and they [illegible] the only remedy was to order out their telephones, but that even this was impracticable unless all were willing to dispense with the instruments. A committee was appointed to invite all physicians and druggists who are telephone subscribers to be present at an adjourned meeting to be held Monday night. At this meeting it was generally conceded that it would in all probability be impossible to obtain the consent of all physicians and druggists who are subscribers to have their telephones taken out. Dr. Lewis spoke in favor of preparing a petition to the next legislature, asking it for legislation that would lead to a reduction of telephone rates. A motion to appoint a committee of twenty to canvass the city for the signatures of physicians and druggists who are telephone patrons to such a petition was carried. A committee was appointed to confer with business men and ascertain their views in the matter. A committee was appointed to draft a form of agreement to be signed by each of those desiring to indorse the petition to the legislature. Blanks have been scattered among the drugstores whose proprietors are interested in the fight, to be signed by professional or business men who may feel aggrieved. The league will send in the filled-out blanks or reports, with an accompanying memorial, to the legislature, in order to secure a law regulating telephone tolls, and if possible, reducing the rates. These blanks are to be found in twenty-four of the principal drugstores. A committee has been appointed to obtain information, and secure the names of those claiming to be aggrieved. H.

Cincinnati, O.

CINCINNATI, O., Jan 5.—The Cincinnati Street Railway company has entered into an agreement with the Cincinnati & Suburban Electric Railway company, by the terms of which there is turned over to the latter corporation the Hamilton pike branch of the street railway system in Cumminsville. The Cincinnati & Suburban Electric Railroad company agrees to keep the road in repair and operate it by electricity. This company proposes to run its cars from Mt. Pleasant, Mt. Airy and College Hill through to Fountain Square without change of cars The hump in the College Hill pike, known as Parker's Hill, in Cumminsville, is to be graded down, and the ascent from Cumminsville to College Hill made gradual and easy for all sorts of vehicles, the consents for making the improvement having been obtained from owners of abutting property. The consents of owners of abutting property have also been obtained for the extension of the Hamilton pike branch of the street railroad from Chase street to the north corporation line. The trip can be made from one terminus to the other [illegible] an hour. The Cincinnati & Suburban Electric [illegible] company contemplates going into active operation [illegible] next spring, or as soon thereafter as the [illegible] of the Hamilton pike within the city [illegible]

The Circuit court has decided the case of the [illegible] & Eden Park Railway company against H[illegible] Winslow. The company [illegible] them from removing a pole erected in [illegible] ises by the company, on which to place wires for operating an electric street railway on W[illegible] Maxwell refused to make the injunction [illegible] that before such a pole could be erected [illegible] abutting property holder must be obtained. [illegible]

[illegible] that a street railroad can be operated on the streets, when granted the right to do so by the municipal authorities, without obtaining the consent of a particular property holder, unless some special or [illegible]. The court also found that there was no danger to life or property from the [illegible] electric current over them, that they will not work any substantial injuries to the [illegible] the access to the property. The judgment of the lower court was reversed. Mr. Kerper says that he will now proceed with the construction of the road, and with improvements make it a success.

The ordinance recommended by the Board of Public Affairs was recently considered by the special meeting of the city council. Its object is to allow every electric light company to operate on conditions that poles be confined to alleys or sites of private property, that wires do not interfere with existing wires, and the company pay the city one-half of one per cent. of gross earnings and one cent per foot for every foot of wire used. The question arose whether the ordinance could apply to the Brush company, which has been operating in the city nearly fifteen years, paying the city one-half of one per cent. of its gross earnings. Superintendent Clark, of the Brush company, submitted that it would be rather hard to require his company to pay any more, or to alter its status because new electric light companies operating under a different system [illegible] rights in the streets. An amendment that the comptroller should inspect the books of companies was adopted. A proposition to make the tax 2½ per cent. was not voted on. D.

Detroit, Mich.

DETROIT, Mich., Jan. 5.—The City Railway company having been granted a franchise for an extension to its existing plant will equip the Chene street route with an electric motor. This change has been brought about by the demand for more rapid transit than at present provided, and to meet which electric street railway companies have been organized, and franchises granted to them only to be vetoed by the mayor. The City Railway company is reported as saying that if the Chene street road proves successful electricity will be applied to other routes, and horses gradually dispensed with.

William E. Forbes, an experienced workman in the employ of the Brush company, was instantly killed yesterday [illegible] lamp in Walker's drugstore. It is supposed that he neglected closing the circuit before commencing his work.

Mr. Fred H. Whipple, consulting electrician, is preparing plans and specifications for a city lighting plant at Galveston, Tex., and will proceed thither in a short time to [illegible] C.

Springfield, Mo.

[illegible] Mo., Jan. 2.—At a meeting of the council recently petitions were received from property owners [illegible] the Kansas City Electric Rail[illegible] by [illegible] Lawless of Kansas City, formerly superintendent of the Metropolitan street [illegible] franchise for an electric railway in [illegible] present at the meeting, as was [illegible] Kansas City agency of the [illegible] explained the opera[illegible] spoke in favor of the [illegible] meeting later in the week [illegible] Electric Railway [illegible] for four [illegible] contract for the [illegible] Thomson-Houston [illegible] matter in hand, is [illegible] system. T.

Topeka, Kan.

[illegible] Place. [illegible] work on [illegible]

shall remove all material belonging to it on its own route and from the route of the other. Each company is also forbidden to interfere with the property of the other, or their respective lines.

The new electric light company in North Topeka is working hard to get its plant in condition to start up as early as possible. The first boiler, which will supply sufficient power for the first few months at least, is considerably larger than any at present in the electric light plant on the south side, having a capacity of 125 horse power, about 30 horse power stronger than the last one put in the latter plant.

The Wichita, Kan., Telephone company is figuring on a line down the Missouri Pacific to Anthony, and will also make connection with the Kingman, Newton & Hutchinson. F.

Duluth, Minn.

DULUTH, Minn., Jan. 5.—Duluth is fast becoming an electrical center. The development of the different branches in the past year has been remarkable. The Duluth Telephone company has now over 300 subscribers, and is constantly putting in new instruments. The Duluth American District Telegraph company has in 600 boxes of the New Haven Clock company's system, and is putting in the Warner time system and a fire alarm and patrol system for buildings, docks and elevators.

The Duluth Electric Light & Power company is operating 100 Thomson-Houston arc lights, and 650 Westinghouse incandescent lights. The steam power is furnished by a 200 horse power Hamilton-Corliss engine, and the entire plant is a good one.

The Duluth city fire alarm is of the Gamewell system, with fifty stations.

The Duluth Electric company has just started 600 incandescent commercial lights of the United States alternating current system, which are giving great satisfaction; 600 more will be connected as rapidly as possible. This company is also putting in 150 arc lights of the Fort Wayne Jenney system for street lighting, and will add 2,000 incandescent lights for residence lighting as soon as the city work is done, making the plant, when complete, 200 arc and 3,200 incandescent. Compound condensing high speed engines will be used, with belting direct to the dynamos. O. C. Hartman is president, and F. R. Anson general manager. R.

Council Bluffs, Ia.

COUNCIL BLUFFS, Ia., Jan. 5.—Thomas Officer, manager of the electric light company, says that the season is now so far advanced that he will not be able to do any work at once, but that he expects to complete all plans in a short time and be ready for work early in the spring. The present building will be enlarged and new machinery added. There will also be a reduction in the price charged for lighting, as well as the introduction of the incandescent system.

The electric light plant at the deaf and dumb institute has not yet been accepted. An official test will be made in a few days, as soon as another dynamo, which is now on the road, is received. There are about 375 lights in the building, which present a brilliant appearance when lighted. Two lights in the tower add much to the appearance of the structure at night and also serve to illuminate the grounds.

An ordinance authorizing the Sioux City, Ia., Rapid Transit company to construct an elevated railway and surface railway, and operate by steam, electricity or other power on certain streets, alleys, bridges and public grounds within the corporate limits of the city, passed at the last meeting of the council. The road was planned with the view of using electricity as the motive power.

The Burlington, Ia., Electric Light company has been granted the contract for the city lighting, and 200 incandescent electric lights are to be placed on the streets.

The Brush Electric Light company, which has petitioned the city council for a [illegible] proposes to put in a 2,000 light plant. [illegible] on the three wire system and [illegible] the alternating system. The three [illegible] for store lights and for [illegible] every hour of the [illegible] lights full price will be [illegible] full time, those only in [illegible] Thus the parlor and [illegible] and the bedroom light [illegible] per month for each 16 candle [illegible] proposes to furnish meters [illegible] after [illegible] they propose [illegible] equal to gas at [illegible] I.

THE ELECTRIC LIGHT.

An electric light plant is in contemplation at Versailles, Ky.

North Manchester, Ind., has decided to introduce an arc light plant.

The B. F. Goodrich company of Akron, O., has just puschased a 225-light Brush incandescent plant.

The Sandusky Gas company of Sandusky, O., has just purchased one 65-light and three 30-light Brush dynamos, together with 155 double Brush lamps.

Proposals for electric lighting for a term of three to five years from next May are wanted by the board of public works, Nashville, Tenn., until January 20th.

The Bourse of Paris will shortly be lighted with 2,500 incandescent lamps. The motive power for the dynamos, it is said, will be furnished by compressed air motors.

The Western Electric company of Chicago has sold a 200 light incandescent plant to McCoy's hotel, Chicago. The company will put in its own incandescent apparatus.

The Roaring Fork Electric Light company of Aspen, Col., has recently sent in an order to the Brush Electric company for one 60 to 65-light arc dynamo, together with a number of lamps.

The Washington, O., Electric Light, Heat & Power company has been organized with $10,000 capital, by Judge Daniel McLean, Morris Sharp, Col. H. B. Maynard, F. L. Nitterhouse and Jerome Penn.

Good results having been obtained with the electric lights used on the locomotives of the Berlin-Stralauer-Rummelsburg line, it has been decided to extend their use to the locomotives on the railway running round Berlin.

Not long since two of the officers of the Muskegon Electric Light company of Muskegon, Mich., called upon the Brush Electric company of Cleveland, O., and placed with them an order for a 45-light arc dynamo, and current regulator.

The New York police were greatly agitated the other day over the discovery of what was supposed to be a bomb, and although it was afterward explained that it was a "connection" for electric light cables, the officers deposited it in the river.

The St. Louis Electric Light & Power company has been incorporated, with a capital of $600,000. The shareholders are G. Pantaleoni of Pittsburgh, Pa.; S. M. Dodd, J. C. Van Blarcom, J. W. Bell, E. Whitaker, T. H. West and J. C. Richardson.

Among the recent sales of the Thomson-Houston Electric company are the following: Lime City Gas company, Huntington, Ind., 30 arc lights; Langley, Lowe & Alexander, Chicago, 12 arc lights; Alliance Street Railway company, 500 incandescent lamps.

An exchange reports that "an electric light pole at La Crosse had become so strongly charged with electricity that a beer sign nailed to it gave one man a heavy shock and nearly paralyzed a drunken man." A doubting world will be inclined to believe that the victims had previously been toying with Jersey lightning.

The Joliet Light, Power & Transit company of Joliet, Ill., has been incorporated, with a capital stock of $300,000. The object of the corporation is to build and operate cable, horse or dummy railways in the city of Joliet, and to manufacture gas and furnish electric light and power. The incorporators are Lewis E. Ingalls, John R. Staley and Jason L. Wilson.

In the suit for damages, at New Orleans, instituted by A. Myham and wife against the Louisiana Electric Light company, a verdict has been rendered in favor of the defendant company. The suit was for $12,500 damages caused by the death of plaintiff's son, who was killed some time ago at the works of the Electric Light company, where he was employed.

Omaha is considering the question of burying its wires, and the city authorities recently recommended that the matter of constructing a subway be placed in the hands of a company organized for that purpose. The people of the city are opposed to giving any electrical company the franchise for constructing a subway, but believe all should be compelled to rent of a common company.

There is more than passing significance in the following statement of a St. Louis paper: "Large cities should move slowly in the matter of illuminating gas contracts. The chances are that no coal or water-gas plant in the United States will be worth 20 per cent. of its actual cost five years from now. This is an age of invention, and the eyes of inventors are turned toward the light."

According to a recent ruling of the Supreme court of Pennsylvania the act of 1874, under which the electric light companies were organized, does not extend to them. The court says that if it were intended to embrace a method of lighting by electricity, it is remarkable that no method of distribution was provided. The thirty-fourth section of the act confers no powers to enter upon the public streets for the erection of poles and placing of wires, the privilege of so entering being confined to the laying of pipes only.

The House-to-House Electrical Supply company of West Brompton, England, has about completed its central station and has just issued a circular setting forth the method of supply and assessing the cost of electric lighting. The station will be run on the Lowrie-Hall system, and each consumer will be supplied with a meter. The quantity of electricity actually consumed will be ascertained quarterly and the charge made on the basis of a sliding scale, varying with the maximum supply demanded by the householder, the average tariff being 8d. per Board of Trade unit.

A Hartford policeman, inspired by commendable though imprudent curiosity to solve a mystery, received a repulse that effectually overcame his zeal in scientific researches. On his beat is a wooden pole with crane arrangement for hanging an electric lamp over the center of the street. The crane

is operated by an iron crank, but at the time Officer Heise made his discovery the crank was making the rounds with the man who attends the lights. In its absence the current that came wandering down the pole from a faulty insulation overhead stopped where the crank belonged, and made a pretty little blue flame. It was this flame that attracted Heise's attention, and after reasoning from effect to cause, he thought it would be interesting to learn whether the stray current would light a carbon. Plenty of bits of carbon lay where the lamp trimmer had dropped them, and Heise applied one to the spot where the flame appeared, steadying himself by holding on to an iron lamp post. The next instant he fell back, apparently dead. Later he recovered, but he still does not know whether the current would light a carbon.

A letter from the Heisler Electric Light company says: "The Heisler Electric Light company have been awarded the contract for the lighting of the American part of the Paris exhibition. The whole plant will be completed and tested before shipping, at the St. Louis Illuminating company's station, when the technical societies of St. Louis will be invited to witness the achievement. The same will consist of a dynamo of 1,000 incandescent light capacity, showing the utility of a 2 independent circuit system; each room wired from both circuits. Lamps will be exhibited from 10 to 300 candle power; the automatic regulation will be arranged so as to indicate the reduction of power when lights are turned off; ten miles of circuit wire No. 8 will be inserted, so as to indicate the practicability of carrying the current to any desired distance; registering current meter will be included in the exhibit; twenty-four clusters of incandescent lamps will be suspended from the ceiling of various candle power, posts being provided with side brackets such as used for indoor, but in addition fifty street lamp brackets will be fastened to posts to indicate a system of street lights as used in a great number of our American cities."

A correspondent writes as follows to the London *Electrician* in reference to an electric light installation in Holy Trinity Schools, Eastbourne: "Each square room in the large building is lit by four 16 candle lamps, suspended from the beams near the corners, and one 32 in the center. The smaller one has eight lamps of 16 candle power hanging from beams at regular distances, while each class room has two. This gives a delicious mellow light; but if this were the only advantage our management would not have abolished gas in favor of electric lighting. The great advantage of the latter is, the air does not get vitiated by its use, vitiated not only by the consumption of oxygen and formation of carbonic acid, but by the introduction into the atmosphere of a very considerable variety and amount of deleterious chemical agents, which do much damage to health and property. Take our schools as an example. We have over 600 children in attendance. At this time of the year toward 3:30 we must light up for an hour; the air is already vitiated, and brains begin to be fagged as a consequence. All at once 70 gas jets at least are alight, and each at a low computation consumes as much oxygen as six persons; the equivalent of 420 more people is crowded in, whose breath—well, we will not say what they breathe out, chemists will tell us that. With the new light all this is changed, and the last hour goes, not so easily as the first—that is impossible—but I hardly know how fitly to describe it. I trust to see our church lighted with it ere long—one Eastbourne church is already—and I feel sure that very soon this will become the light, while our old friend gas, to whom we are grateful for past favors, will more and more take the place of coal for heating and cooking purposes."

THE ELECTRIC MOTOR.

It is proposed to connect Oil City and Rouseville, Pa., by an electrical railway three miles in length, at a cost of $15,000.

The Denver Electric Motor company has been incorporated. The capital stock is $15,000, and the incorporators are John F. Donnellan, W. W. Anderson, M. B. Pierce and Henry C. Frost.

Sioux City wants electric railways, but is opposed to the erection of poles necessary for an overhead system, as the telegraph and telephone wires have just been placed underground. The Street Car company is examining storage battery systems, as it considers the introduction of the overhead system hopeless.

The recent trial trip of the Euphrat electrical railway cable car at San Francisco was successful. Dr. Euphrat claims for his system that storage batteries, overhead wires, and consequently, poles, are dispensed with. The Euphrat patent is described as covering an elastic insulation of the wires, which is provided with a slit extending longitudinally, and capable of admitting the passage of a brush. An arc light will be used as a headlight. The surface of the track on which the test was made is rough. It is about an eighth of a mile in length, is arranged in the shape of a horseshoe, and contains many sharp curves. Two horse power will operate a car, it is claimed, with a slight additional power for sharp curves. It is also claimed that the cars can be handled without difficulty on the heaviest grades.

THE TELEPHONE.

The conduit for underground wires in Buffalo has been completed, and the work of burying the wires is now in progress.

The Bell Telephone company has introduced its long distance telephone system in Rochester, N. Y., which is connected by a loop with the main line, running west through Avon, and now reaches as far as Buffalo. The connection with other cities farther west will be effected as soon as work can be resumed in the spring.

At a recent meeting of the Paris Académie des Sciences a paper written by M. Aden was read concerning the use of the telephone as a receiving instrument for submarine cables. If a telephone is placed at the extremity of such a [illegible] distinguishing in the telephone between positive and negative currents [illegible] instruments [illegible] applied to the [illegible] right ear, the natural tones of the two telephones being different. Both of these instruments are [illegible] to the [illegible] phone circuit is, however, traversed by another current from a local battery, which passes through one circuit in [illegible] tive direction and through the other in a negative, the vibration being included in both circuits. The strength of this current is [illegible] to be equal to that [illegible] hence, when the positive currents are being sent, the local current in one telephone is cut off, while in the other it is increased, and that telephone alone sounds, and when negative currents are sent the reverse takes place, the other telephone sounding, and in this way the signals can be distinguished.

A writer in the London *Electrician* thus describes the progress of telephony in Germany and Austria: "The government has now definitely decided on building the trunk line from Vienna to Prague for telephonic purposes. This line is to be run quite separately from the telegraph lines, thus insuring an absence of many disturbing influences, and it is to be built of 3-millimeter bronze wire. The government has been much helped by the Telephone company of Austria. In Prague this company is going to very great expense in refitting their exchange with a new switch-board, which will be able to serve single and double lines, and which will enable their subscribers to at once make use of the new trunk line. Other trunk lines are to be carried to Prague, such as a line from Teplitz, another from Richenberg and Brunn, so that soon a large number of trunk lines will join in Prague and connect most of the large manufacturing towns in Bohemia. The exchange in Prague is also growing at a rapid rate, as all those exchanges are doing which belong to the Telephone company of Austria. The sending of telegraphic messages by telephone to the telegraph office is being made much use of by the company's subscribers. In Prague alone over 28,000 have been sent and received by them since January 1, 1888. In Trieste the Telephone company of Austria are also fitting up a new board to greatly improve their service. The calls in Trieste average per subscriber about nine per day, a very high percentage. This new board is being made by the Consolidated Telephone Construction & Maintenance company, in London, and is a greatly improved board, based on the old board known as the 'Consolidated.' It will take very little room, can be extended to serve 1,200 subscribers, and is a board which comes as near doing the work of a multiple board as such a board can possibly be got to do without being a multiple, and will cost, of course, much less than a multiple would. It is believed that the Consolidated company intend adopting this type for their switch-boards. The Vienna company are also rapidly extending their system, and have fitted up their exchange for 2,000, and are extending it to 2 500. They are laying cables for 800 new subscribers, and have all the lines taken up already. On November 26th the first government exchange was opened in Warnsdorf, in Bohemia, a considerable manufacturing town. This exchange was opened with forty subscribers."

THE TELEGRAPH.

The Puget Sound Telegraph company has imported a cable from Germany, to be laid between Seattle and Port Blakeley.

A double line of copper wire for the Bennett-Mackay Telegraph company is being run from Alameda to Los Angeles. The line will run to Mount Eden, and will cross over to Niles, and will thence be continued over the mountains into the San Joaquin valley to Los Angeles.

According to Superintendent W. B. Somerville of the Western Union Telegraph company, the amount of "special" matter taken over the wire by American newspapers in 1875 was 30,000 words, and last year 184,000,000 words of special matter and 337,624,407 words of associated press matter was handled.

A special from Montreal says: Action will be taken in regard to the construction of a cable between Canada and England within the next two or three weeks. A prospectus giving all the necessary information upon the subject, which was drawn up in 1859, has been forwarded to an English company interested in the project.

A telegram from Philadelphia announces the commencement of an action instituted by the attorney-general of the state against the Western Union Telegraph company. It is alleged that the Western Union company, on October 5th, 1887, in violation of the constitution of Pennsylvania, purchased the entire stock and thereby a controlling interest of the Baltimore & Ohio Telegraph company, and [illegible] the same [illegible] shares of the capital stock of the par value of $3,57[illegible] and paid therefor $5,000,000; that the Baltimore & Ohio company was a competing line in the state with the Western Union, and that its stock and franchises were, by reason of the sale, [illegible] to the state. For the same reason the attorney-general [illegible] a decree of forfeiture and escheat of the [illegible] property and franchises of the Western Union company [illegible] also a forfeiture of the line, franchises, and property of the Baltimore & Ohio Telegraph company of Pennsylvania, [illegible] cause of such purchase and consolidation. The [illegible]

[illegible]

facilities [illegible]

[illegible] necessity arises.

[illegible] curred in the reading which made the dispat[illegible] firm secured a judgment for damages against the com[illegible] on this statement of facts. [illegible] asked for a new trial on the ground that the compan[illegible] not liable for the errors because the printed heading on the telegraph message [illegible] because Lathrop & Co. did not notify the company of the importance of the dispatches, or of the damage lik[illegible] result from errors; and because the transactions of Lathrop & Co. were in the nature of gambling transactions. [illegible] Baker decided that, notwithstanding the printed exemption from liability on the dispatch blanks, the telegraph company was bound to use ordinary care in the transmission of [illegible] grams, and the fact of the errors raised a presumption of negligence. The messages being commercial messages the company had sufficient notice of their importance. As to the transactions being gambling transactions, the court said they were not necessarily illegal. Whether the purchases were legal depended on whether they were actual purchases, and the jury had decided they were. The court overruled the motion for a new trial, and entered judgment on the verdict for $6,698, the difference in prices of purchase and sale, resulting from the telegraph company's error. The telegraph company appealed.

The French Submarine Cable company has formally appealed to the New York chamber of commerce for assistance in presenting to the United States government its charges of conspiracy against the Panama & West India Telegraph company and the International Cable company. About eight months ago the French company opened a direct line from Laguayra, Venezuela, to Dominican ports, and to Mole St. Nicholas, Hayti, and from Mole St. Nicholas to Santiago de Cuba. The companies complained of, however, have refused to forward the messages of the French company from Santiago, it is charged. They claim the exclusive right to conduct telegraph and cable sys[illegible] with Cuba, and look upon the French as an intruder. The president of the French company says: "The West India and Panama company has, I am told, the support of the Cuban companies and of the Western Union Telegraph company in its action against us. I [illegible] this, and am sure if it is true there must have been misrepresentation. We compete with nobody, but simply complete the network of telegraphic communication in the West Indies. Our lines will come in as feeders for all the other cable lines. Our traffic will soon exceed that of the West India company, and to reach the United States and Europe we pass over the Cuba, International, Ocean and Western Union lines. Already, in spite of impediments put in our way, we have sent over 15,000 words and paid these companies over $10,000. The amount would have been five times as great had these companies accepted our traffic in a business like way. If the [illegible] we shall be obliged to lay an independent line, but we [illegible] see why the American companies should drive us to that extremity, as they will lose our traffic [illegible] war traffic. The West India company [illegible] say, are interested in a new cable to [illegible] them a duplicate exit for traffic and lower rates on connecting lines. If the Western Union [illegible] the matter carefully I am sure they w[illegible] thinking, and will see that the interests of the commerce of the United States will be best served [illegible] opening of our lines, and accept telegrams [illegible] The foreign commerce of Venezuela [illegible] last few years, and the United States [illegible] in having cable communication [illegible] the Cuban companies [illegible] company the cable [illegible] had, and then it will [illegible]

Miscellaneous Notes.

[illegible]

[illegible] receives a shock [illegible] into a hasty retreat.

[illegible] was thoroughly [illegible] he had. He happened to be standing on a ledge of rock from which [illegible] was quiet, but he finally noticed a man crawling toward him cautiously on his hands and knees. The alderman naturally inquired why this was being done, and was informed that for the past ten minutes he had been standing on top of a dynamite cartridge, and that the crawler had been trying to set it off by means of an electric wire. The alderman's heel was upon the wire and had grounded it, and that was the only [illegible] off.

An ordinance granting the National Transit company the right [illegible] pipe [illegible] through the city of Chicago will be presented to the council at its next meeting. The Hyde Park board of trustees by a unanimous vote has passed an ordinance granting the company the right to pipe oil through Hyde Park [illegible] street where it will connect with the pipe line in the Town of Lake, for which an ordinance has been already granted, and thence to the city limits, near Ullman and Thirty-ninth streets. At this point it is proposed to take the oil and pipe it through the city along the right of way of the Union Stock Yards & Transit company to the steel mills at Bridgeport.

A new device for target practice is described by a French military journal: At five different points back of the target are placed small open keys consisting of vibrating springs in front of a plate of iron covered with bristling points, a small space separating the contact between the points and the key. The circuits starting from the keys run to an annunciator with five drops, at the firing bench, thence to battery and ground, from the plate behind the target direct to ground. When a ball strikes within the space covered by one of the little vibrating springs it makes contact with the bristling points on the plate back of the target, closes the circuit, and drops its proper shutter at the firing bench. This makes it unnecessary to have a "marker" at the target.

A telegram from Harrisburg announces the granting of the charter of the Marr Construction company of Pittsburg; capital, $150,000. The company was the old Frank S. Marr, contractors, now merged into a joint stock company for the purpose of increasing the stock and also the facilities for spreading the work. It is an electric light construction company which has been in operation for four years, and the increase in business necessitated a further increase in the working force and capital. The chief electrician, Thomas Spencer is now in London, England, supervising the construction of a large plant, while in San Diego, Cal., Brazil, near Rio Janeiro, New York, Maryland, Illinois and other outside places, the company has large plants in course of construction.

Personal Paragraphs.

Frank L. Pope was recently in Chicago. He completed his testimony in the case of George H. Seeley and others against the Brush Electric company.

Fred De Land, who has been connected with the Electric Supply company of Chicago, has taken a position with [illegible] of Chicago.

R. F. Ross, manager of *Modern Light and Heat*, was married last month to Miss Ada M. Henderson, at the residence of the bride's parents, in Moose Brook, N. S.

Prof. John P. Barrett city electrician of Chicago, left for [illegible] He contemplates visiting New York, Philadelphia and possibly Rochester, to examine [illegible]

[illegible] general manager of the Nebraska Telephone company and vice-president of the Midland Electric company of Omaha, was in Chicago last [illegible] accompanied by City Attorney Webster of Omaha.

[illegible] general manager of the Bell Telephone company of Missouri, was in Chicago [illegible] the St. Louis [illegible]

Business Mention.

[illegible]

zinc consumption, and adaptability to open or closed circuit work of any nature." The company also manufactures the Crowdus dry battery, which possesses many excellent features.

The Knapp Electrical works, manufacturers of the Thomas motor, report large orders for the machine. The company is already behind on its orders, particularly in motors of one-fourth horse-power and one-eighth horse-power capacity. The company proposes to put a one-sixteenth horse-power on the market at once.

The Des Moines Electric Railway company has sent the following letter to the Thomson-Houston Electric company of Chicago, in reference to the Des Moines electric road: "We are so well pleased with the operation that I start for St. Louis to-night after two more cars, to bring our number up to eight; we are also making arrangements to build a new power station of 300-horse power capacity. The people are enthusiastic over it; hurry up the trucks; the storm did not bother us as much as I expected. The receipts from four cars, electrically, are four times more than five cars by horses."

The railway department of the Thomson-Houston Electric company of Chicago has received a letter from the president of the electric road at Scranton, Pa., of which the following is an extract: "The motor longest in use has, since the first two weeks it commenced to run early in August, and the stiffness worn off, stood the heavy work of our road admirably. We used it at first under a large open car, and frequently carried up the heaviest grades over seventy-five people, and on one or two occasions over 100 people. We changed to one of your heavy Pullman cars in October, and for about six weeks it cost us nothing for repairs; all that we spent on it was for oil, waste and cleaning. These cars weigh as much empty as an ordinary street car does when loaded. They were especially built for strength, the wear and tear on our heavy grades and numerous curves and switches being very heavy. We have had running for about ten days one of your trucks under a long car with a seating capacity of about forty people. This car is the fastest car on an up grade I ever saw; it is somewhat lighter than our two Pullman vestibule cars, but with its capacity well filled it fairly jumps up the hills. We have now three of your trucks in business, and expect by the middle of January to have two more; the trucks are awaiting the cars."

Electrical Patents.

Issued January 1, 1889.

395,311. Insulating Support for Secondary Battery Electrodes. Henry F. de B. Cameron, Detroit, Mich.

395,315. Electric Signaling Apparatus. John P. Coleman, Swissvale, Pa.

395,317. Sign for Electric Lights. Edward A. Dubéy, Brooklyn, N. Y.

395,357. Controlling Device for the Regulating Members of Clocks. William S. Scales, Somerville, Mass.

395,377. Secondary Battery Charging. Charles F. Brush, Cleveland, O. Filed June 13, 1882. Patented in several foreign countries.

First claim follows: "The combination, with an electrical generator, a main or charging circuit, and two or more secondary batteries included in the main or charging circuit in series, and a discharging or working circuit connected with each battery, of a switch constructed and arranged to switch all said batteries into the charging circuits, and an electro-magnet included in the charging circuit, and adapted to actuate the switch and automatically and simultaneously switch all said batteries into the charging circuit."

395,378. Secondary Battery Charging. Charles F. Brush, Cleveland, O. Filed June 13, 1882. Patented in several foreign countries.

First claim is appended: "In a multiple arc system of electrical distribution, the combination, with an electric generator, a main or charging circuit, and a secondary battery included in a multiple arc branch of the main or charging circuit, of a switch for electrically connecting and disconnecting the secondary battery and charging circuit, and an electro-magnet for automatically actuating the switch and switching the multiple arc branch and the secondary battery included therein into the charging circuit."

395,37[illegible]. Secondary Battery Charging. Charles F. Brush, Cleveland, O. Application filed June 13, 1882. Patented in several foreign countries.

The [illegible] is appended: "The combination, with an electrical generator, a main or charging circuit, [illegible] series, each included in [illegible] the main [illegible] each secondary battery having a [illegible] connected therewith, of a [illegible] battery [illegible]

[illegible] Y. [illegible]

forming the inner rails of two lines of railway, the outer rails of which are parallel with the slot irons upon opposite sides thereof."

395,476. Speaking Telephone. Francis Blake, Weston, Mass.

The claim is as follows: "In a telephone employing a granulated conducting material—as the variable resistance portion of a circuit—a transmitting diaphragm carrying said granulated material loosely upon its upper surface, of a second electrode of large cross-section buried in said granulated material and mechanically connected with the center of the diaphragm to vibrate with it, the said second electrode having free edges."

395,492. Regulator. Alfred Gartner, Newark, N. J.

395,508. Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

The current distributors are maintained in synchronism by electric motors having independent field magnets and armature circuits.

The last claim reads: "14. A synchronizing system for multiplex telegraphy, consisting of a line circuit connecting the different stations, electric motors at the different stations having independent field magnet and armature circuits, the polarity of one being constant and having its poles ninety degrees apart, a current changer in the line circuit for reversing the polarity of the other independent circuit, and a current distributor driven by the moving part of the motor."

395,509. Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

The invention is designed to assure accurate synchronism and the transmission of every signal at the instant when made, while at the same time the capacity of the system is increased. The current distributor assures the development of an induced impulse for signal transmission when the line is connected with the stations holding communication.

395,510. Multiplex Telegraphy. Francis J. Patten, New York, N. Y.

The invention consists in a distributor of special construction which assures a return path for the synchronizing current at all times, and which gives the signaling current controlled by each operator the same path at the proper time.

395,524. Electrically Operated Cutting Device. Russell Thayer, Philadelphia, Pa.

The device is a horse clipper driven by an electric motor.

395,533. Automatic Safety Cut-Out for Electric Circuits. Granville T. Woods, Cincinnati, O.

The last claim is given: "4. In an electric light or power circuit, the combination of a circuit-breaker in the outgoing conductor and a fusible cut-out, a variable resistance device, and a magnet controlling the circuit-breaker in the return conductor, arranged and operating."

395,546. Electric Cable. William A. Conner, Pittsburg, Pa. Filed July 30, 1888.

The invention consists in coating the lead pipe of a telegraph cable with tin or like metal capable of resisting the oxydizing action of acids.

395,556. Vibratory Multiplex Telegraphy. Stephen D. Field, Stockbridge, Mass.

Two claims are appended: "16. In a vibratory telegraph system, a tone-receiver comprising a tuned vibrating fork having an actuating annular helix fixed to it, in combination with a tubular field magnet for polarizing the field in which said helix moves.

"22. A receiving instrument for alternating current impulses, consisting of a vibratory diaphragm and a pair of coils wound side by side, and controlling said diaphragm, both coils being at one end connected to earth and at the other to the terminals of a battery to which the main line is connected at an intermediate point, whereby magnetic lag in such instrument is eliminated."

395,575. Electro-Magnetic Rock Drill. Harry N. Marvin, Syracuse, N. Y.

A series of coils, acting upon one or more cores, is provided with a circular commutator, which is actuated by the cores. The invention relates more particularly to the means for rotating the brushes of the commutator, the devices for turning the drill, and to the method of controlling the force of the blow or stroke, and to other minor details set forth in twenty-two claims.

395,584. Conduit for Electric Wires or Cables. Edward H. Phipps, New Haven, Conn.

The conduit consists of a sheet metal shell provided with a lining of hydraulic cement.

395,6[illegible]. Electrical Switch. Paul H. Brangs, Newark, N. J.

395,613. Electric Harmonic Telegraphy. Mark W. Dewey, Syracuse, N. Y.

395,614. Printing Telegraph. Mark W. Dewey, Syracuse, N. Y.

395,622. Dynamo-Electric Machine. John F. Kelly, New York, N. Y.

The conductors are wound longitudinally upon the armature core, and a series of fan blades, carried by the armature shaft, are placed in position to create a current of air over the exterior of the core and coils.

395,6[illegible]7. Electric Railway Signal. Daniel G. Smith, Pocatello, Idaho.

The first claim reads: "The combination, with a main line circuit extending between two points, a local circuit connected with and of a higher resistance than the main circuit, an air compressor mechanism actuated by a passing train, and a circuit breaker operated by air from the air compressor mechanism to break the main line circuit."

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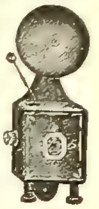

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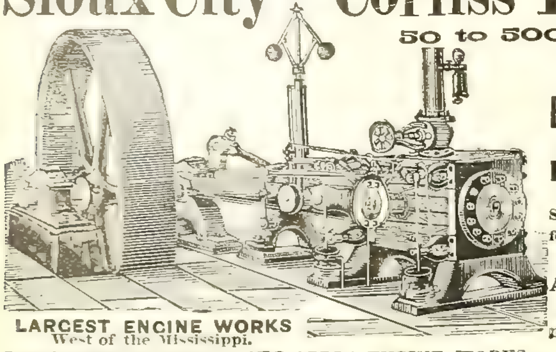

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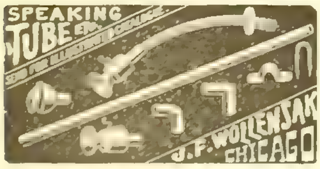

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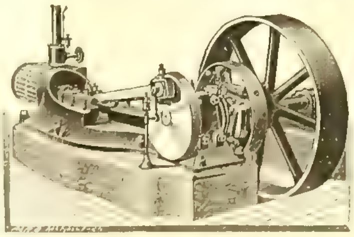

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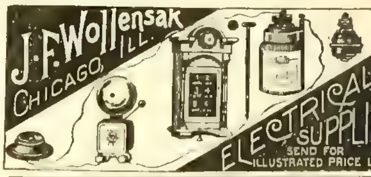

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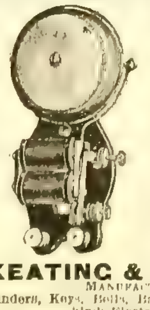

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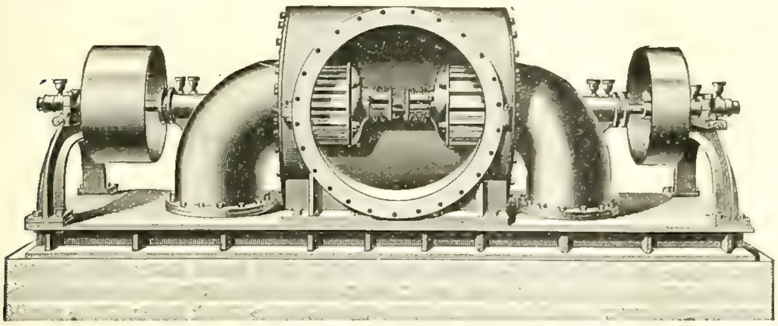

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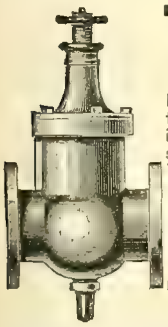

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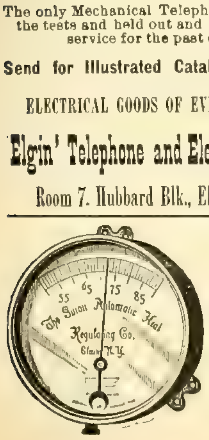

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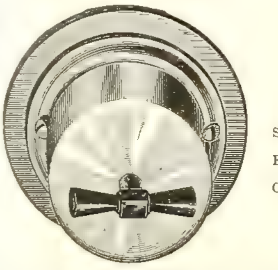

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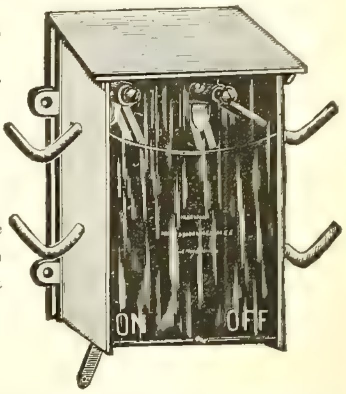

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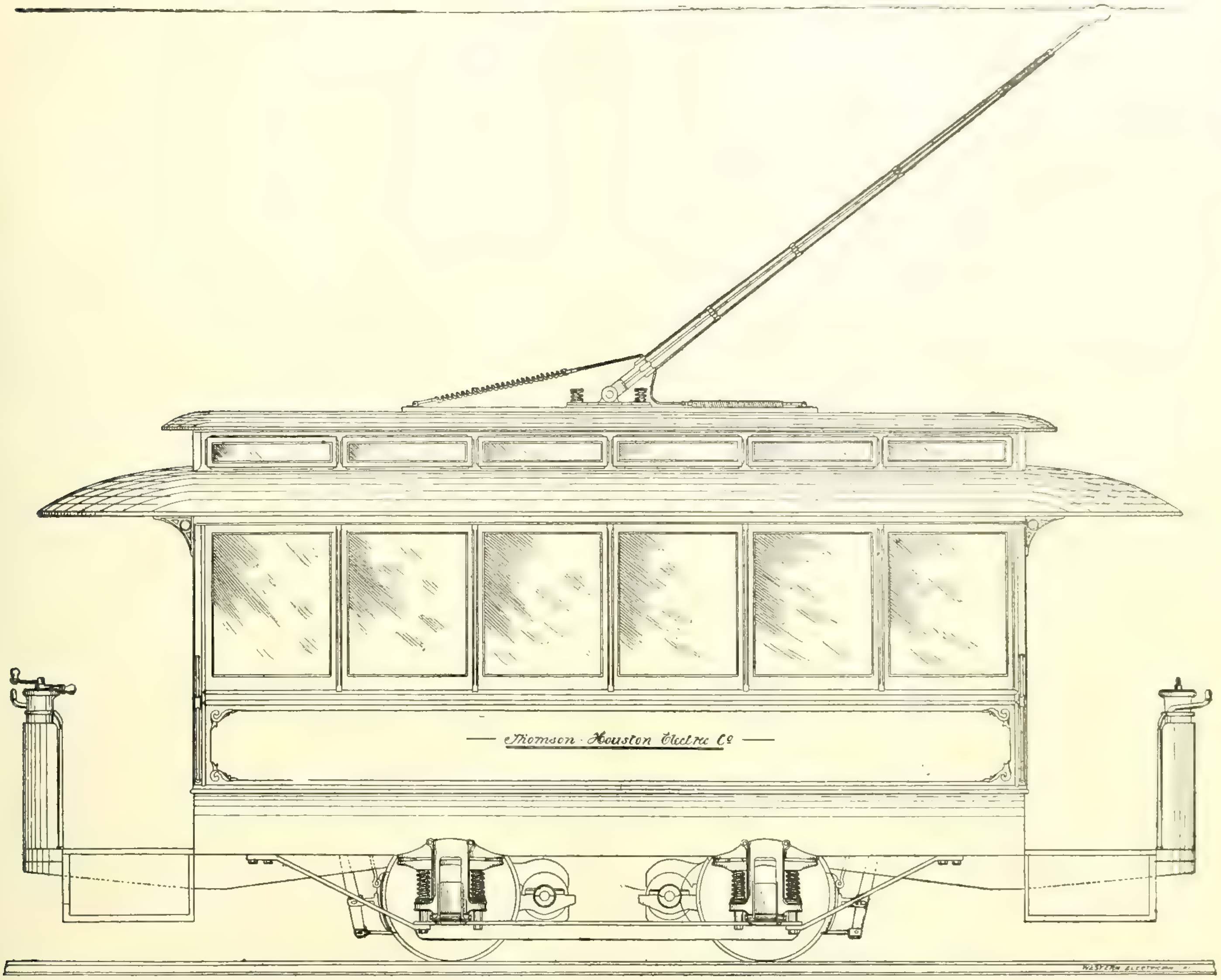

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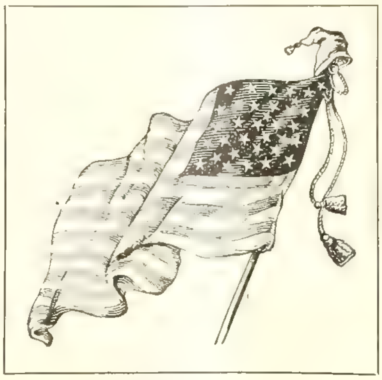

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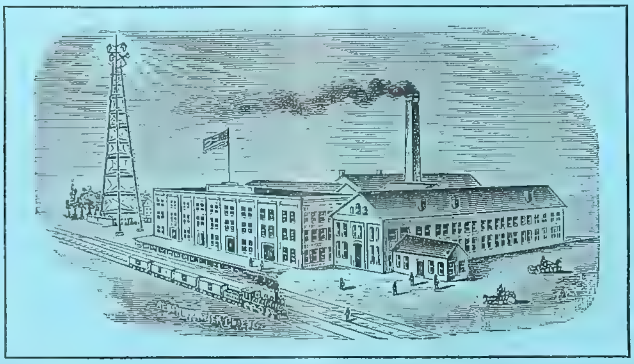

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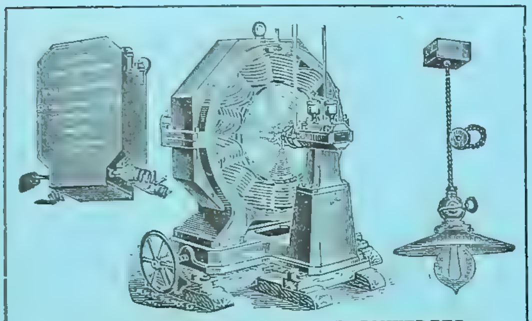

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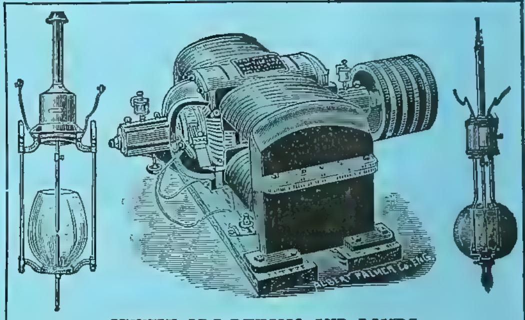

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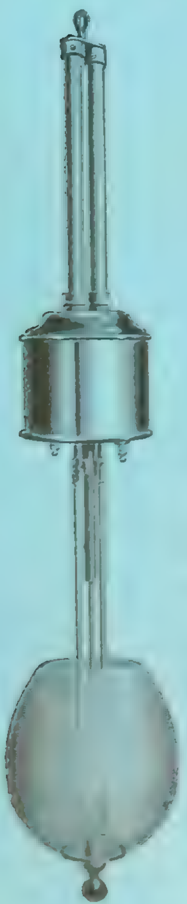

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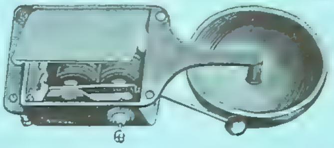

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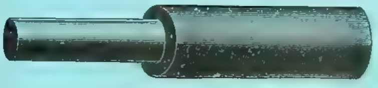

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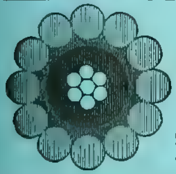

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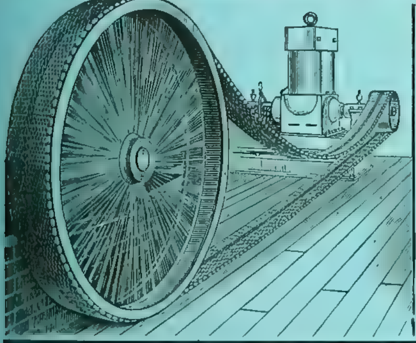

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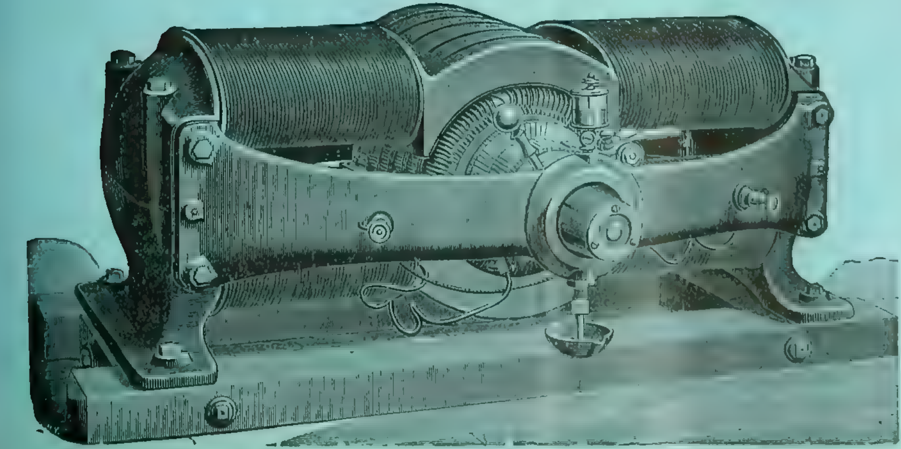

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—OF—

Electric Arc-Lighting

IN THE WORLD.

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—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

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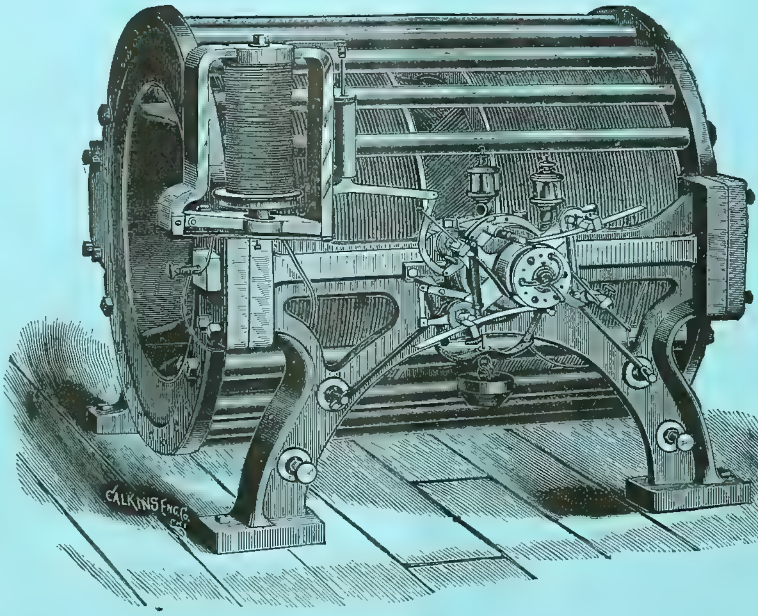

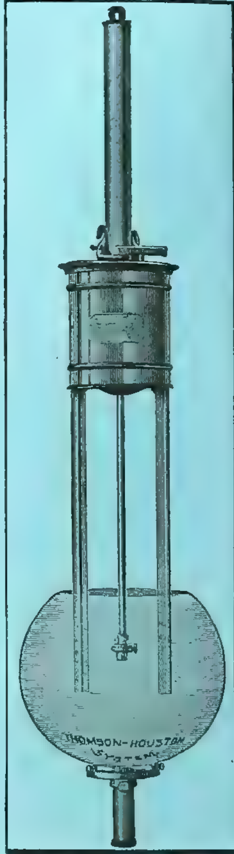

This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

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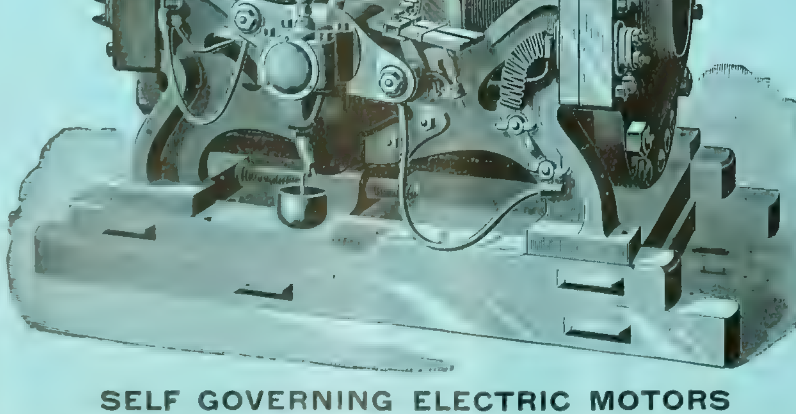
These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.



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The MACRAEON STORAGE BATTERIES do not "buckle," "blister" or "sulphate" -are the simplest in construction -are made with **CLOSED METAL BOXES** -require less attention, and will last longer than any other battery in the market, being practically indestructible and of great efficiency.

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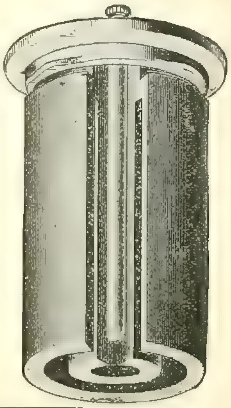

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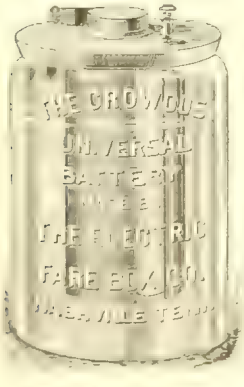

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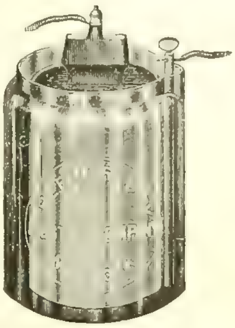

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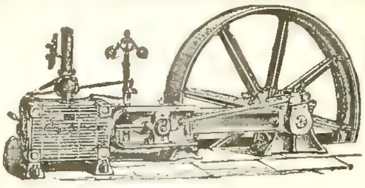

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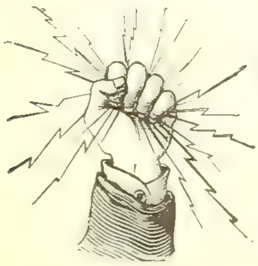
EXCLUSIVE MANUFACTURERS OF THE



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WE MAKE A SPECIALTY OF

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We publish Catalogues of all our Manufactures, and will forward to any address upon application.

N. B.—When applying for Catalogues, please state whether "Electric Bell" or "General Supply" Catalogue is wanted, and if in the trade inclose business card for discounts.

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1,000 Installations. 100,000 Horse Power. 1,000,000 Lamps and $20,000,000 Capital.

Edison Electric Light Co.

THIS COMPANY IS THE OWNER OF THE INVENTIONS AND PATENTS OF

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Which Patents absolutely control this The Only Permanently Established and Commercially Successful

METHOD OF GENERAL ELECTRICAL DISTRIBUTION.

As evidence of the growth and present prosperity of the Edison System, attention is called to the character and scope of a few of the Stations now in operation and under construction.

NEW YORK CO., Capital, $2,500,000, 4 Stations; Capacity, 160,000 Lamps.
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It is significant to note the fact that the Edison Company has during the past year enlisted an amount of capital and put under construction a station capacity far in excess of the aggregate Incandescent work of all other companies combined. Nothing could more forcibly emphasize and attest the accepted value of the Edison Central Station Industry as an investment.

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ALTERNATING CURRENT METERS.

This Company's Meter measures the whole current by a positive mechanical movement.

It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

ALTERNATING CURRENT MOTORS.

Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

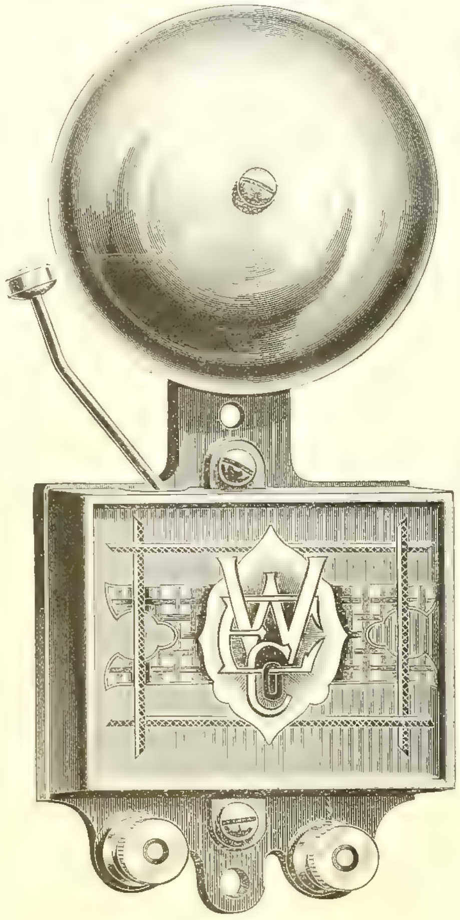
Small Motors for use on existing Alternating Circuits of this Company.

BELLS, BATTERIES AND PUSHES

Quad Carbon Battery.

Prices upon Application

New Style Iron Box Bell, No. 1006.



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Prices upon Application.

Bronze Push No. 1004.

Price, 75 Cents.

Sample Sent by Mail on Receipt of 65c.

Agents for the Gassner Dry Battery.

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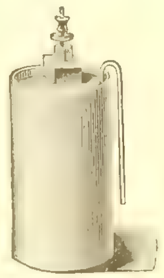
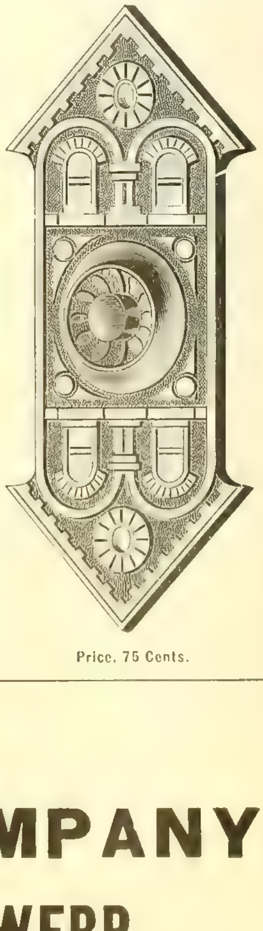


Cylindrical.

Medical.

Bronze Push No. 1003.



Price, 75 Cents.

PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

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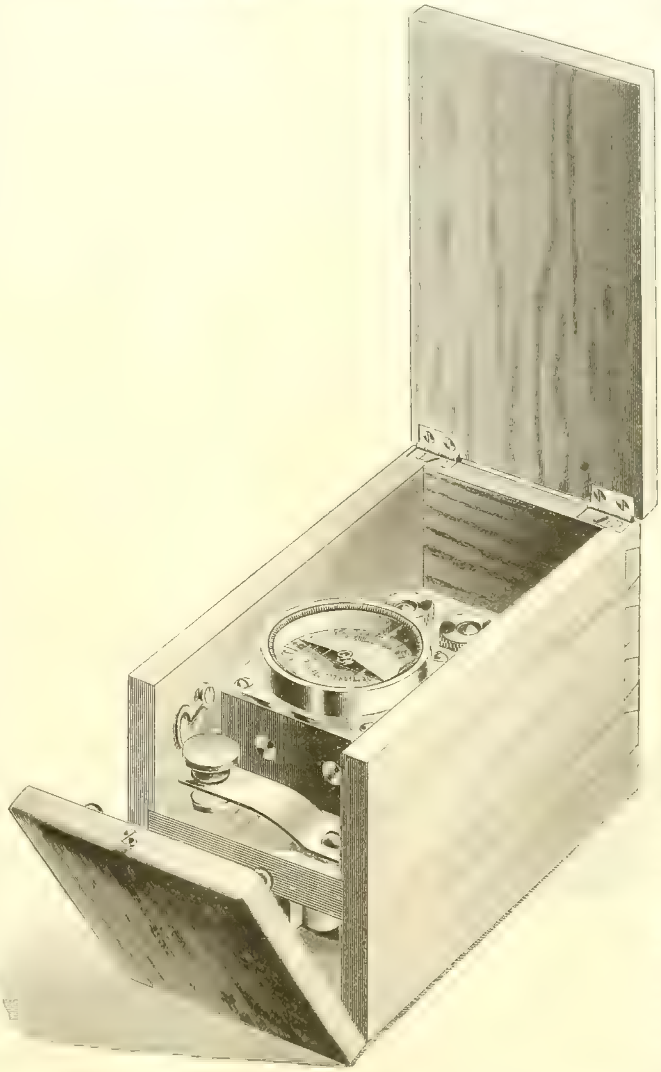
Western Electrician.

EVERY SATURDAY.

Vol. IV. CHICAGO, JANUARY 19, 1889. No. 3

New Testing Set.

A new testing set, designed especially for linemen, dynamo tenders and bell-hangers, is illustrated in the accompanying cut, which shows a highly-polished wood box containing a small *dry* galvanic cell, a detector galvanometer of 200 ohms resistance, a contact key and two binding posts. The box is so arranged that by detaching two hooks the connections between the cell, galvanometer and key can be easily inspected. There is in the upper part of the box space enough to carry wires to be attached to the binding posts and the object to be tested. The external dimensions of the box are $5\frac{3}{4}$x$3\frac{3}{4}$x$2\frac{1}{8}$ inches. Its total weight, including cell and galvanometer, is one pound fifteen ounces. The small weight and the compactness of this complete testing set make it possible for wiremen and bell-hangers to carry it in their pocket or tool-bag. As the battery is dry the box may be handled and carried in any position without the least danger of damaging it. The testing set was designed by F. B. Badt, and manufactured by the Western Electric Co., Chicago.



NEW TESTING SET.

Chicago Telephone Ordinance Signed.

The telephone ordinance has been signed by Mayor Roche. At the last meeting of the council an attempt was made to renew the fight, and a motion was made to reconsider the ordinance. When Mayor Roche announced that he had signed the ordinance, quite a breeze was raised. Alderman Burke said he wanted his motion recorded any way. Alderman Cullerton raised the point of order that an ordinance once approved could not be reconsidered. Mayor Roche made this statement: "I have followed closely the steps taken to secure the telephone ordinance, and have satisfied myself that it is in the interests of the people. Since I signed it the council has no further jurisdiction, except to repeal the ordinance. There were twenty-nine votes for the ordinance, and I judge they were cast in good faith. The matter had my fullest consideration, and I only made up my mind this afternoon to sign the ordinance. There is nothing in the ordinance that prevents the regulation of telephone rates by the city, when we get power to do so. I am in favor of telephone rates not exceeding $75 a year, but we have no law to fix the rates at present. In the meantime we can collect 3 per cent. of the company's gross receipts, and if the proposed law passes the legislature we can still collect this revenue from the company."

Alderman Burke took an appeal from the chair on the ruling that his motion was out of order. Aldermen Dixon and Cullerton took the ground that there was nothing to appeal from, as the charter took jurisdiction out of the council's hands as soon as the ordinance was signed. The mayor decided to be sustained by vote, however, and on roll call this was done by a vote of 29 to 11.

Later in the evening Alderman Ernst introduced an order that the law department shall draft an amendment to the city charter giving power to regulate telephone rates, and also to license telephone companies, the said amendment to be presented to the legislature for passage. The order was passed by unanimous consent.

Clark Telephone Bill in the Ohio Legislature.

The Clark bill for the regulation of telephone charges in the state of Ohio came up for consideration in the house in Columbus January 10th. The measure was introduced last winter, and provides that the rental, where one telephone is used by one individual or corporation, shall not exceed $3 per month, and where two or more are used the rental is not to exceed $2.50 per month. Where cities and towns are connected with telephone exchange the charges shall be 10 cents for the first five minutes, and 5 cents for each additional five minutes. Mr. Clark, author of the bill, opened the argument when the house convened in the afternoon and spoke at length in favor of its being enacted into a law. A number of letters were read from prominent people in different parts of the state, urging the passage of the bill. Mr. Clark charged that with a capital stock of $75,[illegible] the Cleveland Telephone company was now capitalized at $[illegible] He [illegible] the legislature regulate the charges. Mr. Raw[illegible] spoke in favor of the bill. He [illegible] bill had been [illegible] the Cincinnati Telephone company had [illegible] the remonstrance. Mr. [illegible] to take the telephones [illegible] passed. He wanted to try it on and find out. Mr. Leland thought the legislature [illegible] more right to regulate telephone charges than the fees of attorneys. Mr. [illegible] advocated the bill with an amendment that the price be $3 uniformly for all. Mr. Worthington in opposing the bill [illegible] Cincinnati petition the names of Mayor Amor Smith, Judge [illegible] and Judge Peck, asking that the telephone should not be interfered with, as the legislation imposed would impair or destroy the interest. Mr. Outcalt said the bill would ruin the Cincinnati Telephone company. It was six [illegible] a vote was finally reached, resulting in the defeat of the bill by a vote of 54 yeas to 36 nays, not a constitutional majority. All the Cincinnati members voted no. One more vote would have passed the bill.

National Electric Light Association.

B. E. Sunny, chairman of the executive committee of the National Electric Light association, is kept busy in replying to inquiries concerning the exhibits to be made in connection with the February convention. Unless signs fail the exhibition will be by far the largest and most interesting ever seen at a convention. Letters have been received from manufacturers from all parts of the country, asking that space will be reserved for them. The following letter has been issued by the committee:

OFFICE OF THE CHAIRMAN OF [illegible]
EXECUTIVE COMMITTEE [illegible]
NATIONAL ELECTRIC LIGHT ASSOCIATION,
115 Michigan Ave., Chicago [illegible]

DEAR SIR: Arrangements have [illegible] concluded for the use of as much of the [illegible] building as may be required for the meeting of the National Electric Light association [illegible] 19th, 20th and 21st. We have secured [illegible] ing hall and the group of [illegible] rooms [illegible] together about 15,000 square feet of [illegible] space. In addition to this, we have [illegible] great main hall, [illegible] 1,200 feet [illegible] of making exhibits that are too [illegible] other rooms, such as [illegible] By this means we are [illegible] the work of the meeting [illegible] the same time give to exhibitors [illegible] they require, every foot of [illegible] desirable for exhibition purposes.

The plan of the [illegible] committee having the [illegible] make the exhibit as large and [illegible] possible, taking in everything in [illegible] manufactures connected with arc and [illegible] transmission of power, and the [illegible]

So far they have received the most [illegible] ment, and there is no doubt [illegible] foot of the space will be taken.

It is not the intention to [illegible] bers of the association, [illegible] admit all who are interested [illegible] thousands of more [illegible] exhibition being [illegible] for [illegible] this means thousands of people [illegible] meeting [illegible] its attendance [illegible] to warrant the continuance [illegible]

after the sessions of the association have closed. In addition to the issuance of the tickets the exhibit will be well advertised, and every means adopted of bringing together the kind of people that the manufacturers are glad to meet.

For the further information of exhibitors the following may be noted: Goods may be shipped at any time, addressed care of the National Electric Light association, Exposition building, Chicago. Ample time can be had, with plenty of room to unpack and repack goods, with storage facilities for boxes, barrels, etc. There is a side track on the east side of the building, which will make the unloading of bulky exhibits cheap and expeditious.

There is on the premises about 500 horse power boiler capacity, and plenty of engine capacity. Power will be furnished in the spaces occupied by exhibitors by electric motor entirely. The rates for space are as follows, and they are based upon the estimate cost of the enterprise:

For 100 square feet floor space	$15.00
For 100 to 200 square feet floor space	25.00
For 200 to 400 square feet floor space	40.00
For 400 feet and over	10 cents per foot

It is very important that we know at once if you desire [illegible] and if so the approximate space that you will want.

For any additional information, please address A. V. Garratt, 16 East Twenty-third street, New York, or the [illegible]

[illegible]

Chairman Executive Committee.

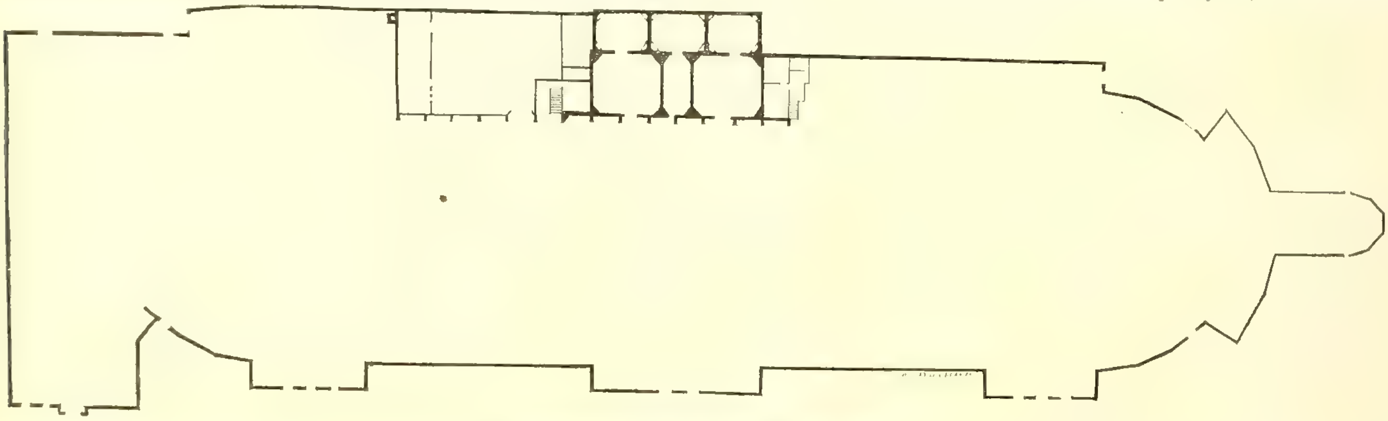
[illegible] give an excellent [illegible] building in which the [illegible] convention will be held. The length, and the average width is 240 feet. It is claimed it is the largest roofed area in the world without interior supports.

Fig. 1 gives a general view of the building. Fig. 2 is the floor plan. The exhibits will be placed in the art rooms, which are partitioned off in the diagram. The main hall will be used if additional room is required. At the left is the dining hall, in which the sessions of the convention will be held. Accommodations will be provided for 600 persons. The rear portion of the room will be partitioned off, and will be used as a press room. A number of small rooms will be at the disposal of the several committees.

The executive committee is hard at work conducting the correspondence necessary to make the proceedings of the convention of an interesting character. The committee on insulation and installation will make its report at one of the sessions. It will be remembered that the failure of this committee to report caused some little discussion at the last convention.

Mr. Lynch's committee on underground wires and the committee on patent legislation will have reports to present. C. H. Rudd of Chicago will present a paper on underground cables. S. S. Leonard will read a paper on petroleum fuel. It will be remembered that Mr. Leonard treated the same topic at the August convention, and the paper led to an extremely interesting discussion.

CHICAGO EXPOSITION BUILDING.



CHICAGO EXPOSITION BUILDING—FLOOR PLAN.

[illegible] installed at Van [illegible]

Automatic Registering Dynamometer.

The accompanying illustrations show an automatic registering dynamometer in which some fluid is used for indicating the amount of power passing through the apparatus, says *Industries* of London. The dynamometer consists of two pulleys, F and L, F being keyed to a horizontal shaft, while L runs loose on the same shaft. On the arms of the fast pulley F are fixed two small cylinders C C, shown in Figs. 3 and 6. The rams of these cylinders are arranged in such a manner that they come in contact with the arms of the loose pulley L, Fig. 2. The loose pulley L is driven by a belt from the fly wheel or the pulley of the machine to be tested, while round the fast pulley F a brake strap is arranged, as shown in Fig. 6. The power from the machine is therefore transmitted by means of the arms of the loose pulley to the water or other fluid contained in the cylinders C, which communicate through small pipes H with a passage A in the horizontal shaft, Figs. 2 and 6. A is connected by a small pipe J to an ordinary pressure gauge G, Fig. 1, which registers the pressure exerted on the fluid in the cylinders C. On the end of the horizontal shaft, and forming part of the coupling for the pipe J, is fixed a worm X, which gears with a small index wheel or revolution counter W. On the boss of this index wheel is fixed a small cylinder B, round which passes an indicating card K. On the spindle of the pressure gauge G is fixed a small pinion which gears with the rack R, to the end of which a pencil is attached. This pencil is in contact with the indicating card, and as this card travels at the same rate as the index wheel, a diagram of the pressures and the traversed distance is obtained. If it be desired to test machines or shafting, the brake strap is removed, and the machine or shafting under operation is driven from the fast pulley F, while the loose pulley L is usually driven. Fig. 5 shows the arrangement for using long indicating cards for extended trials. The barrel B is attached to the boss of the index wheel, and the paper, which is coiled on a drum, is kept in contact with B by a small loose cylinder. The pulley shown dotted in Fig. 2 is sometimes used instead of the pulley F for greater convenience when testing machines or shafting. The advantages claimed by the inventor for this dynamometer are, that in testing an engine the indications are not obtained direct from the brake strap, and also that the indications are free from the friction arising from the moving parts of the dynamometer.

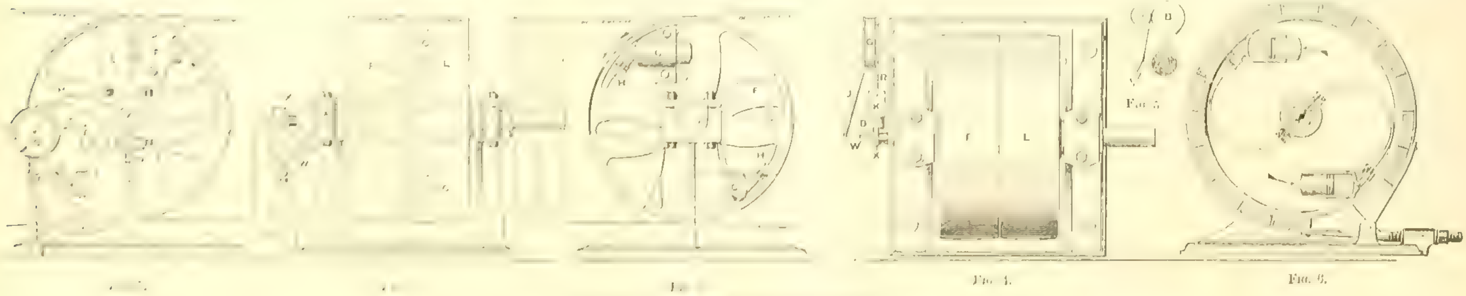


Fig. 4. Fig. 6.

[illegible] DYNAMOMETER.

An Electric Road and a Blizzard.

Last week one of the severest tests to which an electric railroad can be subjected was experienced by the Davenport, Ia., electric line, installed by the Sprague Electric Railway & Motor company of New York. The result proves most conclusively that an electric railway can be operated even under the most adverse conditions of weather. The blizzard which had been howling about the Dakota prairies during the first part of last week, on January 9th struck the city of Davenport. Damp, heavy snow fell all day, and covered the streets to the depth of from four or five inches to one foot on a level, and in several places caused deep drifts over the line of the electric railway. In spite of this, the cars on the electric line kept running interruptedly, carrying a large number of passengers and proving conclusively that no amount of snow could prevent the cars from running on schedule time. The president of the road, W. L. Allen, was greatly pleased by the result, and is enthusiastic over electric railways. This road has been in operation about four months, and has been giving very great satisfaction to the management and citizens of Davenport, who have had a much better service since its installation than they ever had while the road was operated by horses. The cars move faster, are under more perfect control, and are much more easily managed than the cars drawn by animal power.

The Jackson Electric Light company of Jackson, Mich., will install a Westinghouse system as soon as the addition to its works is completed.

The Zipernowski-Deri Alternate Current System.

BY [illegible]

I read with interest the statement in the Western Electrician of January 12th that the Zipernowski-Deri transformer system was to be commercially introduced into the United States. It struck me at the time that I had never seen a full and complete description of this interesting system in any of the American electrical journals, and as I have lately returned from Europe, where I had an excellent opportunity of thoroughly looking into the merits of this apparatus, I have undertaken the preparation of this article. The alternate dynamos for lighting by means of transformers made in the United States are all representatives of one type. They all have drum armatures revolving inside of the field, consisting of an iron drum carrying a number of magnets with their poles directed toward the armature. The main type of European alternate dynamos for transformer distribution is that of Ganz & Co. of Budapest, Hungary, which is manufactured under the Zipernowski-Deri-Blathy patents. This system is in operation in a considerable number of central stations on a paying basis. The Zipernowski alternate dynamo belongs to that type which has a stationary drum armature, the field with its radial magnets revolving inside. The smaller dynamos are self-exciting, while the lager machines have separate exciters. That the e. m. f. may be kept constant in the primary coils of the transformers which, of course, are connected in multiple arc, the dynamos are compounded [illegible]

[illegible] shown in the cut. The radial fiel[illegible] their respective coils constitute the moving part. The commutator has as many segments as there are magnet poles in the machine, the alternating segments being in electrical contact with each other, as shown in Fig. 3. At each reversal the commutator so directs the alternating currents that the several impulses follow in the same path in the coils of the magnets, and thus the machine becomes self exciting. The current necessary to excite may be taken as a shunt to the terminals of the generator or from a special armature coil reserved for this purpose. The exciting current may also be [illegible] transformer called a magnetizer, [illegible] the main line or the terminals of the generator. In all these cases the exciting current [illegible] the dynamo to be already [illegible] be of nearly constant e. m. f. and strength. But for maintaining a constant e. m. f. at the terminals of the generator it is necessary [illegible] the magnetization in proportion to the [illegible] of the external current supplied [illegible] and as it is even desirable to have a [illegible] higher e. m. f. when the generator is [illegible]

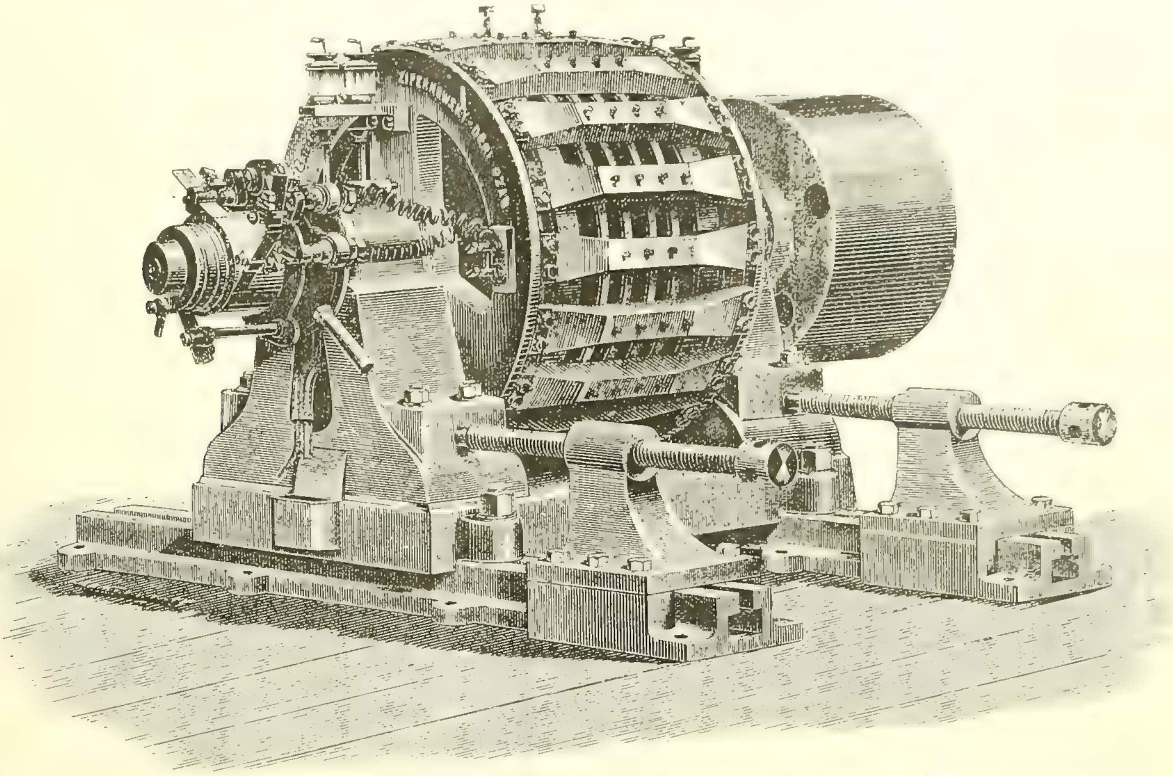


FIG. 1. ZIPERNOWSKI-DERI ALTERNATING CURRENT SYSTEM—SELF-EXCITING COMPOUND DYNAMO.

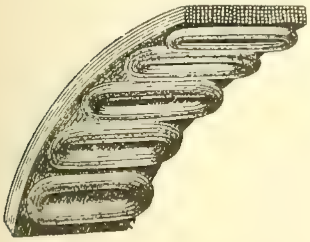


FIG. 2. SECTION OF ARMATURE.

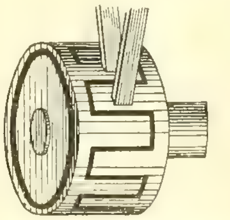


FIG. 3. COMMUTATOR FOR SELF-EXCITING ALTERNATING DYNAMO.

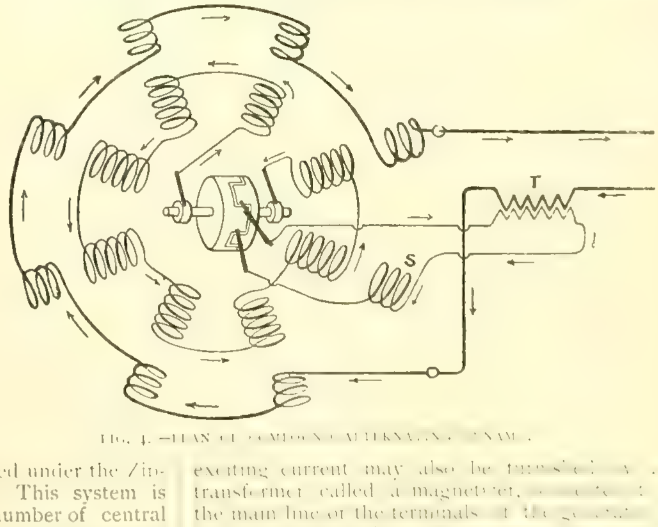
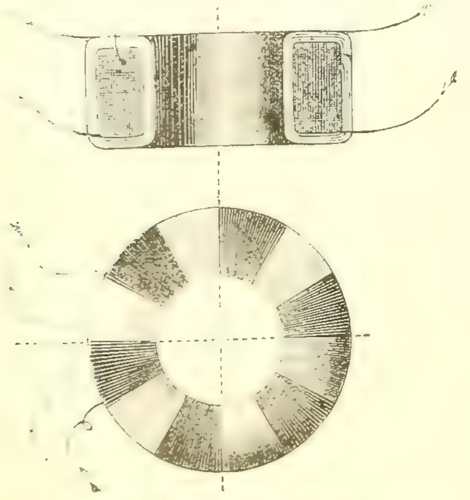


FIG. 4.—PLAN OF COMPOUND ALTERNATING DYNAMO.

[illegible] open circuit, the magnetization will have to be increased very considerably. In this case the magnetizing current [illegible] of a special transformer, or compensator, while the second coil of this compensator is introduced in the main circuit of the generator in such a manner, that the two currents are circulating in opposite directions round the iron core. The two currents will mutually act upon each other, and the effect [illegible] current will increase and decrease, corresponding to the changes in the main current. If the original exciting current and the compensator are properly adjusted, it will be possible to maintain the e. m. f. constant, not only at the terminals of the dynamo, but at the end of a conductor of given length. The e. m. f. at the terminals of the generator will rise somewhat with the increasing intensity of the main current. By such an arrangement the influence of part of the resistance of the high tension main line can be done away with in cases where the nearest object to be supplied is situated at a considerable distance from the central station. Fig. 4 is a diagram of an eight coil compound alternate dynamo. The inside coils are those of the field, and the outside coils those of the stationary armature. The current of the armature coil *S* is reserved for the magnetization of the field, and for this purpose is connected with the commutator. *T* is the compensator. It is clear that instead of using the current of coil *S*, a transformer might yield the magnetizing current for the field.

Ganz & Co. build their alternate dynamos in the following sizes:

	1	2	3	4	5	6	7	8
W[illegible]	10,000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	320,000
[illegible]	[illegible]	830	[illegible]	[illegible]	[illegible]	[illegible]	170	125
[illegible] nets	6	[illegible]	[illegible]	[illegible]	14	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	85	85	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	93



[illegible] o. 1.

The Zipernowski transformers have been de- [illegible] well known [illegible] Two forms are [illegible] Fig. 5, a ring [illegible] made of thin iron [illegible] with two coils [illegible] of a Gramme [illegible] ings, however, are connected in [illegible] current circulates [illegible]

Difference of potential at secondary terminals . . . . 102 [illegible]
Ratio . . . . 15 to 1
Strength of primary current 4.25 amperes
" " secondary " 75
Primary energy consumed, with full 8017 watts
Secondary energy supplied load on 7650 "
Commercial efficiency 95.4 per cent
Reversals of current . . . . 100 per second.

On open secondary current this transformer will take 17 amperes of primary current, which is equal to 210 watts of energy expended, though the apparent product of volts and amperes will give about 50 per cent. more

Prof. Galileo Ferraris, who made a series of experiments and measurements at the Italian Museum of Industry in Turin, concludes his report, in which he compares transformers of the Gaulard and Gibbs and Zipernowski and Deri types as follows:

The comparisons which we have just made are sufficient to demonstrate that the annular form of transformer is much better than that of the disk secondary generators. This is easily explained, for we can demonstrate *a priori* that the form of the annular transformer is not merely very rational but that it is, perhaps, the best of all that could be devised for the purpose of obtaining great coefficients of induction with low resistances and small weights of copper.

1 To have a large surface of spirals with the smallest possible mass of metal, we must remove as much as possible of the metal from the center of the spirals, and consequently we prefer wire to disks.

2. To obtain the largest surface of spirals possible with the least length of wire, we must have a small number of spirals with a great diameter.

3. To give the iron core the maximum efficiency it is advantageous to give it a closed form. Now the layer of iron which covers the annular transformer is evidently equivalent to a core closed upon itself.

4. To avoid Foucault currents the continuity of the iron must be interrupted precisely as it is done by employing instead of a single mass, a varnished iron wire, rolled up in such a manner as to be everywhere perpendicular to the currents.

We are thus led, quite naturally, to the arrangement adopted by Zipernowski, Deri and Blathy.

Lastly, it must be noted that the induction produced by the currents which circulate in the coils of the annular transformer is sensibly independent of the place which these coils occupy in the interior of the stratum of iron, where they are entirely inclosed, and that consequently, both in the annular transformer and in that with the disks, the primary and secondary coils are under identical conditions as regards the iron.

Ganz & Co. manufacture, in connection with their alternate dynamos and transformers and necessary appliances, also alternate current meters and alternate motors, of which a description will be given at some future time. They do not make incandescent lamps, but use in their stations lamps of various manufacturers, such as Siemens, Edison-Swan, Cruto and others.

Electrical Course at Columbia College.

The announcement that a school of electrical engineering was to be established in New York, from which students may graduate with a thorough training in electricity, similar to that which is insured in engineering by graduation from the school of mines, has been received with favor by electricians and all those interested in the growth of electrical work. The development of industries involving the use of electricity has reached such enormous proportions that the want of facilities for instruction in the subject has become a matter of serious consequence to those who have the management of these interests as well as the actual care of the apparatus employed.

The new field demands a class of men whose claim to accurate and scientific training is sufficient to entitle them to report upon electrical questions, and take sole charge of technical departments.

It may be taken for granted that the authorities of Columbia, in making this move, have not [illegible] The preparation on the theoretical [illegible] allies electrical engineering to the [illegible] professions, is such as will naturally fall within the undergraduate course. At present the [illegible] of the course have to be elaborated. While making liberal appropri- [illegible] etc., it is proposed [illegible] somewhat modest scale [illegible] the foundations may be well laid, paying [illegible] and enlarge as [illegible] for admission seen. [illegible] the incumbent for the [illegible] to be created has already [illegible] that the name will be given [illegible] on.

American Institute of Electrical Engineers.

The regular meeting of the American Institute of Electrical Engineers was held at the college of the City of New York, Jan. 8th. Francis W. Jones presided. E. G. Acheson read the paper of the evening as follows:

LIGHTNING ARRESTERS AND THE [illegible] OF SELF INDUCTION.

If in the opinion of any an apology is required—and it is thought that such will be the case—for thus presenting a subject that is in any of its parts a reproduction of the experimental work of such authorities as Professor Hughes, Professor Lodge, Dr. Hertz and others, the excuse is offered that the original motive thought when entering into the series of experiments referred to in this paper was a legitimate one—the clearing away of a little fog surrounding some annoying phenomena attending the working of cables of electric conductors. The investigation became so interesting, so striking and suggestive, and some of the results appeared to have such a value, that it was believed they would afford sufficient excuse for this presentation.

While the measurements made during these investigations were not as accurate as it would be possible to obtain with more refined instruments, the probable errors were not so great as to make them wholely valueless, care in the readings and many determinations checking to a great extent the errors due to the crudeness of the apparatus. Appreciating the fact that untruthful results are less desirable than none, owing to their misleading effects, it is intended to impress the fact that the determinations contained in this paper can at best only serve as a possible check upon future work of a more complete and accurate character. It is also to be hoped that they may promote the already lively interest displayed by the scientific world in discharges, and the sometimes oscillatory character of electric currents.

The mass of material and composite character of the work to be presented will necessitate considerable care in selecting the order of presentation, and it is believed that the subject can be more easily followed if the thoughts and experiments succeed each other in the order in which they occurred to the experimenter, and this plan will be followed even when the after thought is of the greater importance.

As previously stated, the primary motive from which followed this series of experiments was the clearing up of some uncertainty as to the cause of a few annoying troubles in electric cables. But, to be more precise, it was desired to determine the cause of the occasional "grounding" and failure of cables used in telegraphic and telephonic service, when to all outward appearances they were perfect in construction, protected with lightning arresters, and immediately before the moment of grounding indicated high insu-

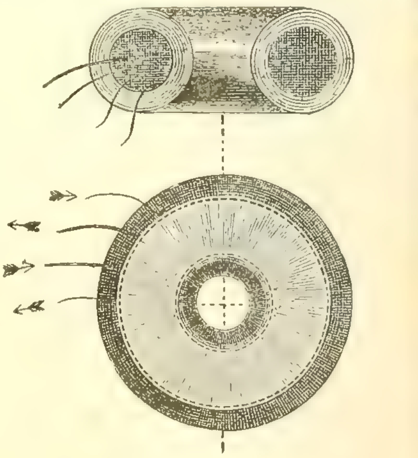


FIG. 6.—TRANSFORMER, FORM NO. 2.

lation resistances. A case of this kind presented itself for solution, in which there were some features of peculiar attraction to an investigator. It was a cable containing five wires about one mile in length, and of that design known as anti induction, the cross section being star shaped, each conductor having a surrounding wall of lead. It was used for telegraph work, and the conductors were connected at the ends to overhead lines, lightning arresters being provided for the protection of the cable; the terminals of the cable were on poles some twenty feet in height. The ground plates of the arresters were connected to the earth in the usual manner; that is, by wires running down the poles to plates in the ground.

This cable was continually getting into trouble, the conductors becoming solidly "grounded" and upon examination it was found that the "grounds" were caused by little kernels or spots of carbonized insulation. It was at the first moment thought that these had been introduced in the manufacture of the cable, but their repeated formation emphatically declared against this theory and made it imperative to learn the true cause. It was not probable that they were produced by the working currents, for they were of comparatively low electromotive forces, while the presence of the lightning arresters would, in accordance with the prescribed rules of their action, render it wholly unlikely that they could have been produced by lightning.

A close study of the experiments of Professor Hughes on self induction, and of Professor Lodge on the "alternative path" had produced an unsettled condition of my ideas as to the true value of a lightning arrester. The work of these investigators, together with some few experiments of my own, had produced a feeling of interest as to the efficiency of even the best arranged arresters as con-

nected in ordinary practice. I was prepared to believe this to be a practical live case of a well-mounted and connected lightning arrester not protecting. It even seemed possible that the cable itself was, in reality, protecting the protector, when viewed in the light of Professor Lodge's "alternative path" experiment.

In order to come to some definite and practical conclusions as to the possibility of these troubles having been produced by lightning, a series of experiments was undertaken on lines somewhat analagous to those of Professor Lodge.

In Fig. 1, the general and important conditions of a cable placed in the earth and provided with lightning arresters as usually connected, are outlined. In the figure *K* represents the cable, *L* the line wire, and *W* the ground wire connecting *C* to the ground plate *G*.

It is generally supposed that lightning—or an electrical discharge, as I prefer to call it—produced by the difference of potential between the cloud above the wire *L* and the earth beneath, would, upon striking the wire, pass to the lightning arrester *C*, jump across the space separating the points to the wire *W* and thence to the earth, or the reverse, as the case may be. But while this is probably the case in many instances, it has not yet been satisfactorily demonstrated that there have not also been many cases where this plan of procedure was materially departed from the discharge making a path for itself through the cable and the insulation, or perhaps dividing itself between both routes. In order to obtain more clearly defined ideas of the action of a discharge under these conditions, the apparatus shown in Fig. 2 was used, in which it will be seen that the fundamental principles and connections of Fig. 1 are reproduced for experimental work, the cloud being represented by the inner coating of the Leyden jar *J*, and the earth by the outer one, the charge being produced by an Holtz machine, of which *M* and *N* are the conductors. The long length of the cable in Fig 1 is replaced by a short one *K*. As before, *L* represents the line wire, and in this case is connected directly to the conductor *O* in the cable. The lightning arrester is replaced by an equivalent *C* composed of two points separated an appropriate distance. The wire *W* is, as before, the ground wire connecting *C* in the former case to the earth, and in the latter to its equivalent, the outside of the jar; the lead covering of *K* is also connected by means of a short wire to the same outer surface. While in Fig. 1 the point on the line *L* which is struck by lightning is subject more or less to accidental conditions, it is in the case of Fig. 2 selected and adjusted by the ball *X* as is also the value of the energy of action, by the areas of the surfaces on the jar *J* and the length of the striking distance *A*.

With the apparatus arranged as just described and illustrated, it was quickly determined that a discharge could with great ease be caused to pass through the insulation of the cable, even when the space *C* was but a fraction of the distance through the insulation, and the length of *W* a few inches of stout copper wire. The current of discharge seemed to divide itself, a portion passing by *W* producing a spark at *C*, and another portion passing through the cable. A few more experiments also demonstrated that the wire *W* had apparently as much influence on the results as the space *C*, and consequently it became necessary to analyze the combination more completely to determine the relative values of *C* and *W*. With this object in view the cable *K* was thrown out of the combination, and the connections simplified to those shown in Fig. 3. On close examination they will be found to be in every way similar to those in Fig. 2 with the exception of the replacing of the insulation of the cable *K* with a clear air-space *B*, instead of connecting *L* to the conductor *O* it is here connected to a post *P*. The spaces *C* and *B* were both adjustable to a fairly accurate degree, *B* being easily readable to thousandths of an inch.

The system of experimentation was to take a certain length of wire *W* adjust *A* and *C* to known values, and then adjust *B* so that one spark would occur there for about every ten at *A* and after having noted the length of the spark *B* a few inches would be cut off from *W* and *B*, readjusted and again noted; this being repeated until *W* was wholly consumed. The values of *B* for these various lengths of *W* and a known length of *C* having been obtained, a wire similar to the original *W* was substituted for the former, and *C* having been removed from the circuit, as shown in Fig. 4, a similar set of tests were made, and the differences between the results with and without *C*, indicated the true values of *C* and *W* in the combination, while the results with *W* alone show the value of each additional inch.

In plate *A* the results of these measurements have been plotted into curves. The length of *W* in inches is plotted horizontally while *B* in thousandths of an inch is laid out vertically. The capacity of the jar *J* was .0025 m. f., and *A* was retained uniformly at .25 of an inch. The full line curve is that of *W* without *C* in the circuit, while the dotted one is that obtained with it in. The length of *C* was .02 of an inch. *W* for both tests was composed of a copper wire having a diameter of .052 of an inch.

A brief study of these curves teaches that, when *W* is but a few inches in length, *C* plays a very important part in determining the length of *B*, and also that its influence rapidly vanishes as *W* is lengthened, and actually produces an opposite effect after a certain length of *W* has been arrived at. Thus with *W* 20 inches long, *C* has a value equal to 50 per cent. of the total circuit, at 110 inches it appears to have no value, while at 150 inches the value of the compound circuit is about 7 per cent. less than *W* alone. These points are, however, of even less importance than the lesson to be learned from study of the curve of the results obtained with *W* alone. Here [illegible] a relatively small amount of energy contained on the surfaces of the jar *J* will, when discharged into the circuit composed of the air space *A* and the wires *L* and *W*, cause the passage of energy in the form of a spark at the point *B* of a length of over one third of [illegible] and this when the wire *W* is but 20 feet in length, or that of an ordinary ground wire down a telegraph pole.

This does not look very encouraging for lightning arresters with long ground connections, and rather [illegible] ridicule the fine adjustment of the points of these devices. The subject will, however, stand more than a little study and investigation before forming judgment, and perhaps the arrester is all right after all, in so far as the close adjustment is concerned, even if the long ground connection does have to go.

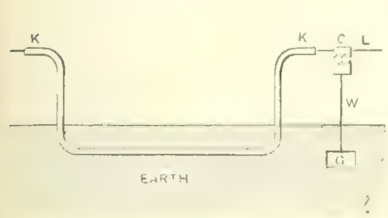


FIG. 1.

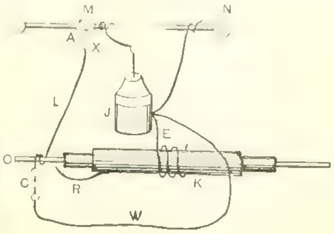


FIG. 2.

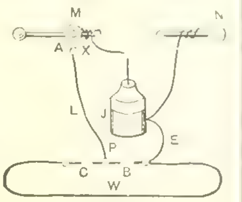


FIG. 3.

Those who are familiar with the recent investigations of Prof. Lodge, investigations so exceedingly interesting and now so celebrated that few there are who have not made themselves familiar with them will at once have recognized in Fig. 4 connections very similar to those used in the experiment of the "alternative path," by Prof. Lodge. The results obtained by him and in the present experiments are in the main the same, and those differences that do exist are probably to be attributed to the following facts: Prof. Lodge's work was done with instruments of great precision, the sparks were always produced between balls or rounded surfaces, and the object was to determine laws and formulate the mathematics of those laws; while on the other hand, the experiments now being presented were made in some cases under the most difficult conditions, with apparatus limited to a most exceptional degree both in quality and quantity, a certain portion of the sparks were produced between points, and the object in view was to dissect, analyze and subjugate the pheromena under examination to and for the benefit of practical work, the every day affairs of the electrical profession.

After a considerable portion of this work had been done and the conclusions more or less formulated, I was much pleased and greatly strengthened in the opinions then being formed to learn through a letter from Professor Hughes to Professor Lodge, published in the London *Electrician*, issue of September 28th, 1888, that Professor Hughes had, at least formerly held the same views of the "alternative path" that I had formed, and which will now be presented in connection with what is thought to be experimental demonstration of their truthfulness.

[illegible]

the cable [illegible]

[illegible]

Heaviside [illegible]

We here [illegible] American and English definitions, as so forcibly stated by Professor Ayrton [illegible] the result of [illegible] tance to stopping. While Professor Lodge's theory would account for it by inertia with the English interpretation of that word—a resistance to motion.

Accepting the belief that the spark *B*, when adjusted to the critical point, was caused by the self induction of the wire *W*, a variety of experiments were made with the desire of obtaining experimental proof of the theory. Repeated opportunities presented themselves for mathematical work, and if time and attention could have been given in that direction, the results would unquestionably have been of interest and value, but the work was perforce restricted to the more limited confines of experiment and reasoning. The first experiment of the series was to replace the wire *W* in Fig. 4 with one of smaller diameter, and redetermine the value of *B* in a manner already done for [illegible] having a diameter of .052 of an inch, and of which the results have been plotted in Plate *A*.

Before presenting the experimental results, it is desirable to consider what might be expected from these changed conditions. There will in all cases be practically the same amount of energy discharged into the circuit, for the areas of the condensing surfaces on the jar *J* remain constant, the length of the striking distance *A* also remains uniform, and while it is true that the resistance of *W*, as measured by a Wheatstone Bridge, would vary inversely as the square of the diameter, the resistance of the complete circuit of discharge is, owing to the air space *A*, practically infinite, and hence the relatively trifling resistance of *W*, even when of the finest wire, may be wholly neglected.

The theory that the self-induced or extra current in a wire is a recoil action, is based primarily upon the hypothesis that there exists, before the electrifying current is discharged into the circuit a prior state—the *electro tonic* state of Faraday. This *electro-tonic* condition consists in the existence of lines of energy—thermal they may be—with directions coinciding with the radii of the wire; these lines or axis of energy being surrounded by circular lines of magnetic force. An electrical current being discharged through such a wire would cause under the influence of its well-known magnetic whirls or circles, whose planes are at right angles to the line of propagation and in this case to the axis of the wire, a deflection of the planes bounded by the closed lines of magnetic force surrounding the radial lines of energy which are within the wire. The work of producing this deflection would, I think, constitute what is known as the variable resistance which meets a sudden discharge, and which was made the subject of that grand paper on "Self-Induction," by Professor Hughes before the Society of Telegraph Engineers, at their meeting of January 28th, 1886. This deflecting of the radial lines of energy, while constituting a resistance to its [illegible] source of, or rather, during the act of deflecting, produces, an electromotive force contrary to that of the inducing current. This counter electromotive force exists only during the interval [illegible] quickly vanishes from the path [illegible] On the moment of the interruption [illegible] rent, and consequent withdrawal [illegible] whirls or circles the deflected radial [illegible] back to their radial positions, p[illegible] electromotive force of such a [illegible] in the same direction as that of the [illegible] return swing or recoil, as of a spring [illegible] of such a velocity, and [illegible] be likened to the tail [illegible] tent, produces a momentary [illegible] higher than that of the original current [illegible] tions of the forces and energies [illegible] understand what dire[illegible] through which the original current [illegible] upon the value of the [illegible]

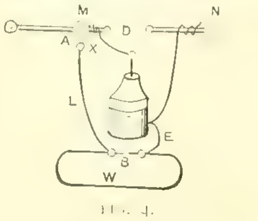


FIG. 4.

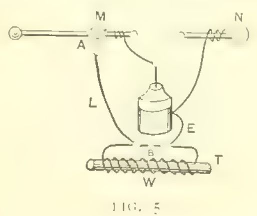


FIG. 5

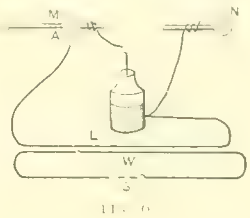


FIG. 6

Referring to Fig. 4, it will be seen, as has already been stated, the conditions and arrangements of *W* and *B* are such as to produce and actually constitute the "alternative path," as shown by Professor Lodge. The simple assertion that they are alternative paths does not, however, make them such and, while they may under certain conditions and adjustments become so, it is possible to conceive of their being otherwise. It is not within the bounds of reason to assume that the energy that has been discharged from *J* traverses the wire *W*, and in doing so produces a condition that may be termed *electrification*, and on the disappearance of the controlling influences of this energy, would not the wire *W* return with an almost infinite rapidity to its original non electrified condition and, in doing so, produce as the result of this enormous rapidity of motion, an electromotive force at its terminals of a greater value than that of the original energy? In other words, will there not be a restoration of the energy expended in distorting the lines of energy within the wire, and this restoration being performed in a shorter interval of time than that occupied in its production, a higher electromotive force would be obtained even though the value of the return would be less than that of the original, to an extent equal to the losses due to the internal friction of the mass.

This being the case, this current of discharge from the wire, and which was first discovered by Henry and investigated by Faraday, and called by him the [illegible], would, owing to its greater electromotive force, jump the space *B* and thus close its circuit, even when the distance was such as to prohibit the passage of the original current as discharged from the jar *J*.

termed, the self-induced electromotive force. All of the experiments and considerations will be made under the conditions of a constant capacity for the jar J and uniform length of A, and consequently one value for the energy discharged into the circuit. In both cases there will, of course, be a certain amount of the energy that has been discharged into the wire lost and converted into heat. This lost energy will be greater in a wire made of smaller wire than in the larger in a proportion inversely as their diameters. This greater loss in the small wire and resulting reduction in the available inducing energy would, of course, tend to produce a diminution of the self-induced current. This re-

see the B spark increase as the energy discharged increased; but I was wholly unprepared to have it decrease as the result of added energy, after a certain point had been arrived at, and still less prepared to obtain the wavy curves, as shown.

Time will not permit of entering into any considerations of the peculiarities of these curves.

There is a little experiment, the record of which I wish to interline at this point; it may answer a question, and perchance wet the powder of some intending questioner. Looking over my sketches and coming to Fig. 3, the thought struck me that an error might have been intro-

of cotton-covered copper wire, with a diameter of .033 of an inch, was used for the wire W. It was arranged in the form of a circle. A was, as before, .286 of an inch, and capacity of J was .0025 m. f. The critical point of B was found for these conditions, and W was then formed into a figure whose two sides were parallel, and B was measured for various distances between the two sides. These distances were, however, only approximate.

Position of W.	B in inches
Circle	.182
Sides separated $3\frac{1}{4}$ inches	.170
Sides separated $2\frac{1}{2}$ inches	.137
Sides separated 2 inches	.137
Sides separated $1\frac{1}{2}$ inches	.137
Sides separated 1 inch	.137
Sides separated $\frac{1}{2}$ inch	.114
Sides separated $\frac{1}{8}$ inch	.050

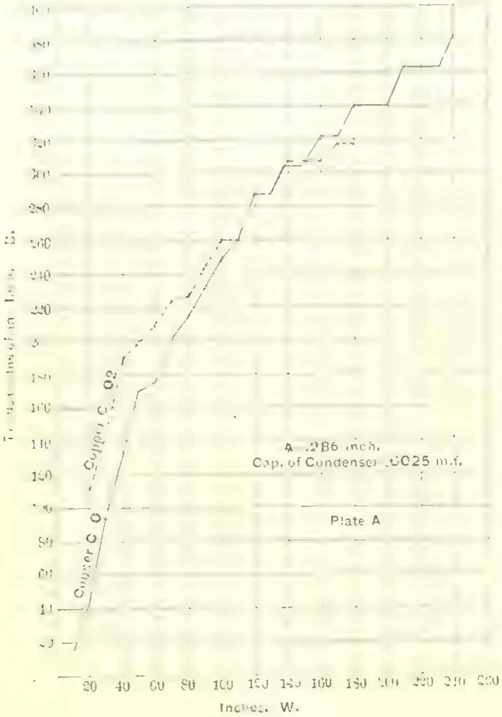


PLATE A.

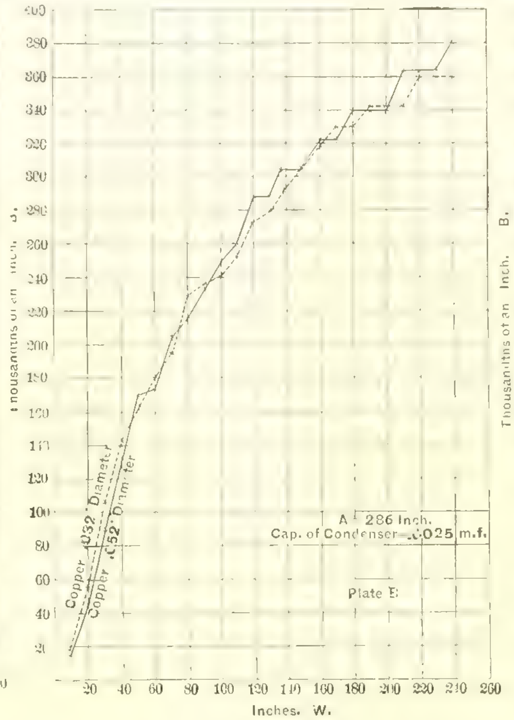


PLATE B.

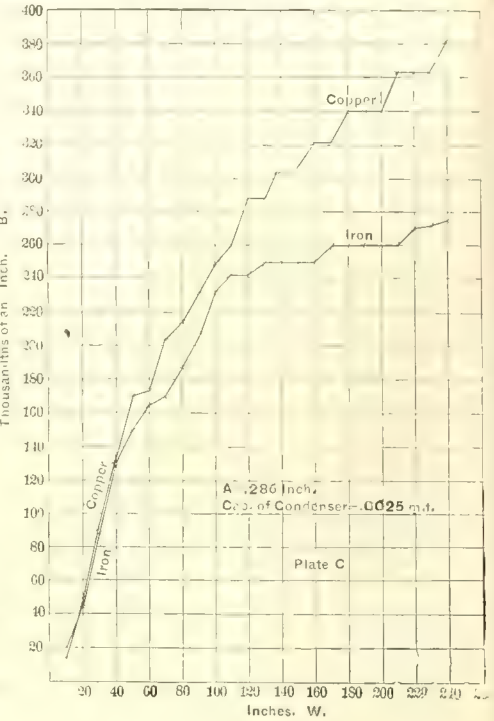


PLATE C.

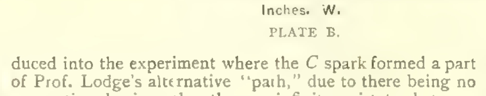
duction is, however, exactly offset by the greater concentration of the inducing energy, its inducing value having been increased in a proportion inversely as the diameters of the wires.

It is feared this argument has become tiresome and an immediate relief will be found in Plate B, where I have platted two curves; one, the full line curve, is the same as that shown in Plate A, and was produced as formerly stated. The dotted line curve was made with a wire of copper having a diameter of .032 of an inch. The two curves are so nearly alike as to permit of the belief that they are in reality the same, and that the slight differences existing are due to errors of measurement. Here is experimental proof that the electromotive force of the self induced current, as measured by the spark B, remains constant as long as the energy discharged into the circuit is of uniform value, and is wholly indpendent of the diameter of the wire, and this seems to give countenance to the argument immediately preceding.

It is more than probable that those who have been following the subject closely will, before this time, have had the question asked, from somewhere within: "How would these curves on Plate B have looked had one been made with an iron wire?" The answer is ready at hand on Plate C. It is not exactly an answer to the question as stated, for there are here shown two curves, one produced with an iron wire and the other with a copper wire, but [illegible] of the same diameter, .052 of an inch. The curve of the copper wire is the one you are already familiar with.

This paper has even now attained to such proportions, [illegible] to present, that nothing more than a moment's glance at these curves can be offered. [illegible] lengths of 40 inches, copper and iron will, when acted upon inductively by discharges [illegible] currents of like electro- [illegible] inches they show slightly [illegible] their tendencies [illegible] much lower than [illegible] approaching a ma- [illegible] Up to 40 inches of [illegible] discharges [illegible]

duced into the experiment where the C spark formed a part of Prof. Lodge's alternative "path," due to there being no connection having other than an infinite resistatce between the ball X and the outer coating of J, while in all of the other experiments there was the circuit formed by W. It seemed possible that this change might have produced a different value for the energy of the discharged current, as the difference of potential between M and X might be al-



Millionths of a Microfarad.

PLATE D.

tered. To decide the question, the connections as shown in Fig. 4 were used. The balls forming the terminals of the Holtz machine were caused to approach each other until the discharges occurred about an equal number of times between them [illegible]. Next the space B was adjusted to the critical length. If the existence or non-existence of the wire W and [illegible] metallic connection between [illegible] the potential of discharge [illegible] the potential difference [illegible] of the discharges to occur. The experiment, however, did not prove this to be [illegible] W having no apparent [illegible] the sparkage that occurred [illegible] removed every [illegible]

[illegible] to determine the effect [illegible] part of the wire W [illegible] The connections [illegible] A length of [illegible]

The next experiment, illustrated in Fig. 5, was to take the same wire W and coil it upon a paper tube having a diameter of $\frac{1}{4}$ of an inch, the wire forming a spiral of one layer about two inches in length. This spiral being placed in the position W the critical point of B was found to be .197 of an inch, or over 8 per cent. greater than when the wire was in a circle. While the spiral was in the last position an iron wire one-tenth of an inch in diameter was inserted into the paper tube, and now the spark B only measured .170 of an inch, over 13 per cent. less than without the iron wire, and more than 6 per cent. less than the plain circle. Another experiment was made like the last, with the exception that the iron wire was long and bent around into a closed circuit, but it did not alter the results. The lowering of the value of the self-induced current upon the introduction of the iron wire was to me at the time startling, but a consideration of the case showed that it should be so, for a portion of the energy of the inducing current was absorbed in producing work in this mass of iron, and of a necessity weakened the self-induced current to an extent measured by the work this extracted energy could and would have done in the wire W had it not been withdrawn. I have, however, here a confession to make. I was all of the time considering that this energy was expended in producing magnetic effects in the iron wire until a friend who had called to see some of the experiments suggested that I insert a copper wire instead of the iron one. I did so. The effect was the same as that obtained with the iron wire. The explanation was simple: It was that not magnetic effects, but electric currents, closed upon themselves within the wire had been produced. The reduction of the length of the spark B now became a simple question of causing the inducing current to do more or less work external to the wire W, and as another means of causing it to do so, the spiral was surrounded by another spiral of wire with the ends so arranged that they could be connected or opened as wished. With this arrangement, the spark B could be made to come and go, as desired; for by adjusting it to the critical point with the terminals of the outer spiral open, it would entirely disappear when they were united, all of which agrees perfectly with the former experiments and conclusions.

Another short series of experiments was conducted with parallel circuits, as shown in Fig. 6. The lengths of the parallel sections were 35 inches, the distance separating them being .2 of an inch. The total lengths of I and W were [illegible] inches. A and J were of the same values as heretofore used.

The conditions of the tests and the resulting lengths of the spark may be briefly stated thus:

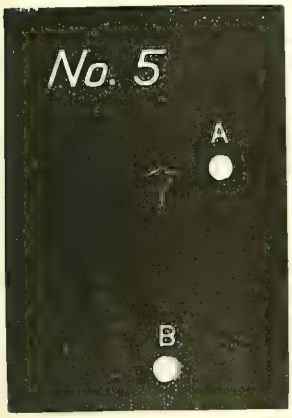
[illegible]	I [illegible] W [illegible]	[illegible]
[illegible]	I [illegible] W [illegible]	[illegible]
[illegible]	I [illegible] W [illegible]	[illegible]
[illegible]	I [illegible] W [illegible]	[illegible]

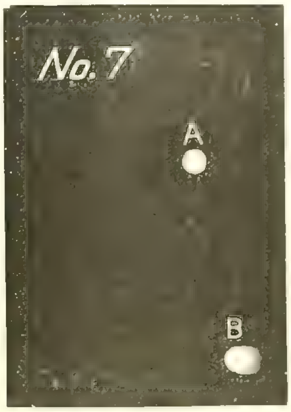
If my memory serves me right these results are the same, qualitatively, as those obtained by Professor Hughes, and clearly show the apparent sluggish action of iron both in imparting and receiving magnetic inductive effects. Its relations to these magnetic effects resemble the actions of a polished metal surface when associated with heat; it radiates and absorbs poorly.

It now becomes my pleasant duty to present the concluding and, at the same time, most interesting and convincing proofs that *W* is not an "alternative path," but that the spark *B* is produced by, and consists of, the discharge of self-induced current. I have called this series of experiments "The Photographic Study of Self Induction."

Unfortunately, at a late day, a day so late as to prevent my repairing the loss, I met with at least two accidents, and each of them cost me one or more negatives which were a part of the record of these experiments. I shall, however, endeavor to make those remaining demonstrate the desired point.

In making these experiments the end in view was to ob-





tain photographic records of the duration of the spark *A*, with and without the spark *B*; with and without the wire *W*; with various lengths of the wire *W*, and, if possible, to detect a difference of time between *A* and *B*. A disk of tin plate, twenty inches in diameter, was mounted on an arbor and belted to a system of pulleys of such sizes that by working the train by hand a velocity of about 75,000 inches per minute could be given to a circle of holes that had been punched in the disk at a distance of one inch from its edge. These holes were about one-eighth of an inch in diameter and one inch apart from center to center. The disk was so placed in relation to the positions of the *A* and *B* sparks that a line stretched from *A* to one of the holes in the upper edge of the disk would pass through *B*. Immediately back of this same hole a sensitive plate was fixed so that the hole was in front of the center line, while the plate was removed sufficiently far to avoid being touched by the disk.

One-half of the sensitive plate projected above the edge of the disk; this upper portion was covered with a tin plate in which a hole was punched of a size similar to those in the disk. The lower portion of the sensitive plate—that is the part back of the disk—was also covered with a tin plate in which a window had been cut a little over one inch square, and in such a position that the holes in the disk passed in front of it. It will be understood from this description that while the disk revolved there could be two holes in front of the window, while there could not be less than one. With these adjustments sparks *A* and *B*, separately or united, would produce an impression upon the sensitive plate, through the upper hole, and through one or two holes, as the case might be, in the revolving disk.

As a result of the accidents above referred to, it will be necessary to introduce the series of experiments with photograph No. 5, where we have the spot produced through the hole in the upper stationary screen marked *A*, and a spot lower down on the plate marked *B*, which was produced through one of the holes in the revolving disk. The object in having the spot *A* was that it might offer a means of comparison between impressions made through stationary and moving apertures, and also show the effect of vibrations, if any existed, in the various parts of the apparatus. The value of the energy discharged through the circuit from *J* was disregarded, care, however, being taken that there should be no change in it throughout the entire series of experiments. The velocity of the apertures or holes in the disk was fairly but not absolutely determined to be 75,000 inches per minute. With this velocity of movement a displacement of the apertures of the one-thousandth of an inch would represent an interval of time equal to $\frac{1}{75000000}$ part of a minute.

The series of experiments will be divided into four sets as follows:

Experiment 1, photo No. 5.—The wire *W* was of copper, 76 feet long and .052 of an inch in diameter, the spark *A* was $\frac{1}{10}$ of an inch, and was retained at this for the entire series.

The *B* spark was adjusted to a point near the critical state, but, owing to the necessity of its production with the first *A* spark, it could not be set to the same delicacy of action as heretofore. The photograph shows a slightly blurred or indistinct outline on the right-hand side of the spot *B*, which is more clearly brought out by comparison with the spot *A*. From this it is concluded that a measurable length of time was occupied by the spark, as the aperture in the disk through which this *B* spot was produced must have moved an appreciable distance in order to have produced this elongation or "ghost," as the photographic profession would term it. Owing, however, to the aforesaid [illegible] this [illegible] of the [illegible] the spot it cannot be assumed that [illegible] in the [illegible] *A* and *B*, or at least, [illegible] value to permit of measurement with the apparatus.

Photograph No. 6.—In producing this photograph [illegible] of the conditions remained the same as [illegible] photograph No. 5, with one exception of the [illegible] was removed from the circuit by separating the [illegible] yond the striking distance. Here [illegible] rather [illegible] and one-half, were in front of the [illegible] the moment of sparking, and produced the [illegible] two. These spots exhibit displacements that [illegible] measured on the negative, are one-tenth of an [illegible] length, and show a duration of the spark of not [illegible] of a minute.

From these two photographs the conclusion [illegible] that the spark *B* shortens the duration of the spark at *A*.

Experiment No 2, Photo No. 7.—The conditions of the circuit in this case were: Wire *W* shortened to twenty inches in length; spark *B* still out of circuit. This photograph shows about the same length, but darker "ghost following the spot *B* than did Photo No 6, and indicates a corresponding increase in the work done at *A*.

The conditions are the same as the last, excepting that the *B* spark is again introduced. While there is still a measurable duration to the spark, the shortening of the interval due to the spark *B* is very decided.

Experiment No. 3, Photograph No. 9.—In this experiment the entire apparatus associated with the spark *B* was cut out and the outer surface of the jar *J* was connected by a short copper wire to the ball *X* (refer to Fig. 4). An examination of the photograph indicates that *A* existed for an interval of time approximately equal to that of the last experiment (photograph No. 8) and very much less than that shown in photographs Nos. 6 and 7.

Photograph No 10.—In this case the wire *W* was removed and the spark *B* adjusted to about $\frac{1}{16}$ of an inch. There seems to be, possibly, a very slight increase in the time over that of photograph No. 9

Experiment No. 4, photograph No. 13.—To this photograph special attention is invited. The conditions under

which the negative was produced were wholly different from the foregoing. The tin plate covering the upper half of the sensitive plate, and which carried the aperture through which the spots *A* were made was removed, the plate was lowered, so that a point represented by the spot marked 1 came on a line with the aperture in the disk. The wire *W* was composed of fifty inches of cotton-covered wire like that used in some of the earlier experiments, and was formed into a circle. The *B* spark was removed and was not used during this set of experiments. The *A* spark was, as before, $\frac{1}{10}$ of an inch, and the spot 1 in the photograph is its impression through an aperture in the disk, and, as readily seen, shows a very considerable duration of time.

The sensitive plate was now elevated a little, the wire *W* was coiled into a spiral, as described in a former experiment, and the spark *A* was once more caused to pass. Spots 2 and 2' are the impressions produced by it, and as will be seen by close inspection exhibit longer "ghosts," and consequently a greater interval of time than was shown in spot 1. Once more the sensitive plate was moved upward, and an iron core having been inserted into the paper tube upon which *W* was coiled, the spot 3 was produced by another spark, the "ghost" produced being

[illegible]

manner recharged, but, of course, in the opposite direction and of a slightly lower potential, will again discharge into the circuit—the discharge at a reduced potential being facilitated by the thermal and, possibly, magnetic conditions of the air space *A* and which were produced by the first spark.

This second discharge will leave the jar *J* once more charged, and will be followed by other discharges of a continually decreasing value, until the energy has been dissipated as heat or into other forms of energy through and by the various portions of the circuit. This subject of the oscillating discharge has lately received, at the hands of Dr. Hertz, a masterly and most highly interesting treatment

Referring once more to photograph No. 6, which was produced by an *A* spark with *W*, composed of a copper wire 76 feet in length, the impression produced by the original, or first spark, is clearly defined, while in its wake is traced the track left by the sparks produced by the rapidly weakening, oscillating, self-induced currents—a track fading away like the tail of a comet, to an invisible end.

The next step in the inquiry is to determine the effect of introducing the spark *B*, and for this purpose reference will be made to photograph No. 5. Here we find, as would be expected, that the comet-like tail has almost disappeared, the natural result of having offered the self-induced currents from the wire *W*, a means of short-circuiting themselves across the points at *B*. The slight trace of a tail—a blurred outline—is to be attributed to the self-induced currents of the portions of the discharge circuit lying between the points of *B* and the surfaces of the jar *J*.

Shortening the wire *W*, with the spark *B* [illegible], should have the effect of increasing the amount of energy dissipated in the air space *A*, and [illegible] should be little or no alteration. [illegible] dissipation [illegible] may be [illegible] total circuit into which the energy [illegible] charged and which consists of the [illegible] and the connecting wires [illegible] from which the energy [illegible] fore, [illegible] which of necessity [illegible]

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[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

THE authorities of Columbia college, New York, have decided to establish a school of electrical engineering.

ELECTRIC cars have met a blizzard in the west, and have demonstrated that they are able to cope with it far more successfully than horse cars.

R. G. DUN & Co., in their weekly review of trade, say: "There are signs in Europe that the copper trust is trying to cast upon the people part of its accumulating load through the organization of a copper bank."

IT will be noted in the St. Louis correspondence that it is proposed to construct an elevated electric road in that city on an extensive scale. An elaborate plan of stringing overhead wires is [illegible]escribed in the letter from that city.

THERE appears in this issue an illustrated ar[illegible] well known [illegible] alternating transformer system, which, [illegible] the [illegible] described [illegible]try.

[illegible] defrauded. [illegible] dings [illegible]

[illegible] explain his motor to experts appointed by the court. Upon conclusion of the argument the matter was held under advisement.

A PITTSBURG paper recently published an interview with C. T. Yerkes of Chicago, in which he is reported as eulogizing the cable system as compared with electric railroads. President Yerkes certainly displayed great wisdom in leaving Chicago before giving such a statement to the public. The best evidence of the failure of the cable system is the unanimous opposition to its extension in Chicago.

THE work which the executive committee of the National Electric Light association is performing in preparation for the February convention is noted elsewhere. Manufacturers are preparing to make a noteworthy exhibit of electrical machinery, and this portion of the convention at least will prove interesting to the residents of Chicago generally. The Exposition building, of which a view is given elsewhere, is admirably adapted as a place for holding the business sessions as well as for the electrical exhibits.

THE paper of E. G. Acheson, read before the American Institute of Electrical Engineers, is presented in this issue. The paper is fully illustrated, and the subject is exhaustively treated. The members of the institute consider the paper one of the highest significance, as will be noticed in the discussion. The author made with the greatest care a series of elaborate experiments, the results of which are embodied in the paper. He concluded the subject by giving a number of practical suggestions, which are conclusions based on his experiments.

THE Chicago Electric club is discussing in an extremely practical way the subject of insulation. A full report will be found on another page. At the first meeting at which this topic was brought up, a formula proposed by H. Ward Leonard was discussed. At the meeting of January 7th, the interest centering in a series of formulæ which F. B. Badt offered for the consideration of the members. He did not believe in a single equation, but argued that a separate formula for each system was necessary for the determination of the requisite insulation. The subject is one of the highest moment, and the continuation of the discussion will be read with interest.

MAYOR ROCHE has signed the Chicago telephone ordinance, and the company now has a franchise under which it can extend its business without fearing the threats of litigation from the city council.

The council, however, has taken the first steps to secure from the legislature the authority which will enable it to regulate telephone rentals. Fault has already been found with the proposed bill. It has been urged that its provisions should confer upon the council the right to regulate not only the telephone company, but also the gas companies, the electric light companies, and, in fact, all corporations which are operating under city charters.

There seems to be a very general disposition to secure a reduction of telephone rates. It will be noticed that the residents of Kansas City are making a determined effort to obtain for the municipal authorities the right which will enable them to reduce rentals. The correspondent in that city, in his letter, gives a statement which the president of the company has laid before the mayor and common council. The figures which he gives in support of his position seem to contradict, beyond all question, the idea prevailing in Kansas City that the company is [illegible] money by charging extortionate rates.

In Ohio an attempt to pass the Clark bill, which [illegible] telephone rates very decidedly, failed [illegible]. The discussion of the measure in the [illegible], as will be noticed in the report printed elsewhere.

The New York board of trade and transportation [illegible] the essential features of which are given in the New York letter, [illegible] telephone rates. No one [illegible] upon favorably by the New York legislature. It would undoubtedly be impossible for corporations to transact business by the reduced schedule which it contemplates.

MAYOR GRANT of New York city signalized his entrance into the executive office by defining his position on many questions of public importance, none of which, however, occupies greater attention than the subjects of rapid transit and underground wires. He urges the necessity of affording greater facilities for transportation in the metropolis, and speaks in no uncertain terms of the failure of the present methods to provide adequately for the requirements of the people. The recent demonstration of the practicability of utilizing electricity on street railways will undoubtedly be welcomed by his honor as a solution of the problem of rapid transit. Mayor Grant announces his determination to put the wires underground before his term of office expires. In his message to the board of aldermen, he says: "Notwithstanding the general demand for the burial of electric wires, and for the removal of the poles which disfigure our streets, the nuisance remains unabated. Laws have been enacted which were intended to afford the city relief from this imposition, but either on account of imperfections in the law or remissness of the officers charged with its execution, the poles and wires continue to obstruct our thoroughfares. All the provisions of the existing law should be invoked to remedy this evil, and if they prove inadequate, we should ask the legislature for additional powers."

THE law providing for electric executions in New York state will probably be amended by the present legislature. The act was defective, in that there was no provision empowering any official to construct or purchase the apparatus necessary to execute the death penalty under the new law. It has been stated that pressure will be brought upon the legislature to induce it to repeal the measure, for the reason that there is no substantial agreement as to the best mode of utilizing the electric current as an agent of death. There is no probability, it is said, that the act will be repealed.

Two electrical engineers in Chicago have recently been interviewed on the subject of electric executions. F. B. Badt criticised the report of the Medico-Legal society of New York, the recommendations of which have appeared in the WESTERN ELECTRICIAN. He agreed with it so far as it favored electric executions. Mr. Badt believed the prejudice which exists against execution by electricity was the result of superstition—a disinclination to abandon old familiar methods for new and somewhat mysterious ones. An old German law demanded that criminals should not be executed by machinery; if a man's life was taken it should be taken by a man. To this day the executioner and his ax bestow capital punishment in Germany. The idea of death by hanging was abhorrent to German criminals.

"As to such a use of electricity degrading that useful agent," the professor concluded, "the idea seems childish to me."

George Cutter is quoted as saying: "There is no certainty about electricity when applied to the human body. There is a mystery about it that nobody appears able to solve. Familiarity with electricity does not breed contempt for it. On the contrary, the more you handle it the more you respect it and fear it. No workman in a shop like this is safe until he gets a shock; then he is perfectly safe. He never forgets it. They talk about death by electricity being painless. There is no agony to be compared to that of an electric shock. One of our men was killed here in the shop awhile ago. I saw him struck, and I am confident that he suffered untold tortures. Men frequently recover from electric shocks after being pronounced dead. One of the best and most robust experts in the country received a shock some years ago, which half a dozen doctors pronounced fatal. In a few hours he regained consciousness, and at the end of six months had fully recovered. I firmly believe that if this law goes into effect many a criminal will come to life in his coffin."

[illegible]

ing. That this is correct is illustrated by photographs No. 6 and No. 7, where the conditions were the same except that a shortening of W from 70 inches in No. 6 to 2 [illegible] in No. 7. A comparison shows that while the length of the "ghosts" are practically the same, that of No. 7 [illegible] —more material. In the same manner in which the [illegible] was increased in the space L, so will [illegible] increase [illegible] wire connecting the points at B to the surface of the [illegible], and for this reason the introduction of the spark B should not be expected to cut off the tail from the spot B to the same value obtained with a long wire at W. This is the case, as is shown in photograph No. 8, where W is 20 inches, and B has been returned to the circuit. If the "ghost" shown in photograph No. 8 was due to the self-induced currents in the connecting wire, as has been assumed, then the same results should be obtained by cutting off the entire portion of the circuit represented by W and the apparatus associated with the B points, and short-circuiting these connecting wires. That this is the case is shown in photograph No. 9.

Cutting out W and replacing B did not seem to alter the results very much, if any, from those last mentioned, and this is just what would be expected.

In photograph No. 13 it is demonstrated that the coiling of a wire into a spiral tends to cause a retention of the energy within itself, and is due probably to the gathering up of a portion of the energy radiated or dissipated by one convolution by the adjoining convolution, and thereby restoring it to its own mass. This retarding of the process of dissipation will result in a prolongation of the time of A and consequent action on the sensitive plate, as is shown by the increased length of the "ghost," following spots 2 and 2[1] over that following the spot 1. As would be expected, the length of the "ghost" is immediately contracted upon increasing the rate of dissipation of the energy as results from the introduction of a metallic core in the coil of W, as is illustrated in spot 3.

The final conclusions to be drawn from these experiments are:

1st. The "ground plate" of a lightning-arrester should be connected to earth by as short a connection as may be possible.

2d. When an air line connects to a cable a lightning-arrester should be provided and attached to the armor of a cable by a connection not more than a few inches in length.

3d. When a short "ground wire" cannot be used, one formed of a number of strands may be used, preferably not twisted into a cable.

4th. Any method by which a portion of the discharged current which passes over the "ground wire" may be withdrawn, will tend to increase the efficiency of the arrester.

5th. Under conditions similar to the tests copper or iron may be used with equal efficiency when the lengths are under forty inches, and over this length iron is more efficient than copper.

6th. The resistance of the "ground wire" is of little consequence, but it should have a size sufficient to carry off the charge without overheating.

7th. The insulation in a cable may be punctured by lightning either by the direct discharge due to the points of the arrester being too far apart, or by the current of self-induction from the "ground wire," when that wire is of any considerable length.

8th. Dissipation of the energy of discharge reduces the self induced current.

(To be continued.)

Chicago Electric Club.

The regular meeting of the Chicago Electric club was held at the club rooms January 7th. In the absence of the president and the vice-president, C. C. Haskins was called to the chair. The subject for discussion was "Insulation." The topic was brought before the club by a number of gentlemen interested in electric lighting, who had been called together to discuss it by C. C. Haskins, city inspector of electric lights. At a meeting of these gentlemen, H. Ward Leonard proposed the following formula for the determination of the necessary insulation. Insulation $= \frac{E \times 10000}{C}$. It was decided by these gentlemen to turn the question over to the club for its consideration. The topic was briefly considered at a meeting in December, and was made a special order for the meeting of January 7th.

THE CHAIRMAN: Mr. Badt, have you some remarks to make on this insulation problem?

F. B. BADT: I have thought this matter of insulation over very carefully. In fact, I have spent quite a little time on it. I may state that I do not think that the different cases are fairly covered by one formula of Mr. Leonard. I think we ought to have one formula for electric incandescent lighting, say up to 250 volts, one for arc lighting, one for alternating transformer lighting, one for the mixtures of arc and incandescent, and series multiple, and so on. I have studied over this formula of Mr. Leonard's, and I have found that the insulation is a trifle too low in comparison with what is demanded for arc lighting.

Prof. Badt put on the blackboard the following formulæ and examples:

INSULATION OF WIRES FOR ELECTRIC LIGHTING OR ELECTRICAL TRANSMISSION OF POWER TO PREVENT FIRE RISKS AND ACCIDENTS TO PERSONS.

I. *Direct Incandescent Systems not over 250 volts.*—Thickness of dielectric at least 1/16 inch.

$R_1 = \frac{E \times 25{,}000}{C}$; E is the electromotive force, C is the current in amperes, and R_1 the insulation in ohms. (Measurement is to be made by attaching wire to brushes of dynamo. Brushes must rest on commutator, and all circuits closed and connected to dynamo.)

[illegible]

II. [illegible]

$$R_1 = \frac{E \times 1{,}000}{I}$$

[illegible]

In this case the loss by leakage is .1 per cent.

Example: 50 arc lights, 50 volts each, 1-mile circuit,

$$R_1 = \frac{2{,}500 \times 1{,}000}{1} = 2{,}500{,}000 \text{ [illegible]}$$

The loss by leakage is .01 per cent.

Example: [illegible] arc lights, 50 volts each, 10-mile circuit,

$$R_1 = \frac{2{,}500 \times 1{,}000}{10} = 250{,}000 \text{ ohms.}$$

The loss by leakage is .1 per cent.

III. *[illegible]*, not over 2,500 [illegible]. Thickness of dielectric at least 3/32 inch.

MAINS AND PRIMARY COILS IN TRANSFORMERS.

$$R_1 = \frac{E \times 25{,}000}{C \times L}$$

in which L is twice the distance.

Example: 1,000 volts, 1 mile, 25 amperes, 500 lights.

$$R_1 = \frac{1{,}000 \times 25{,}000}{25 \times 1} = 1{,}000{,}000 \text{ ohms}$$

The loss by leakage is .004 per cent.

Example: 10-mile circuit, 1,000 volts, 25 amperes, 500 lights.

$R_1 = 100{,}000$ ohms. The loss by leakage is .04 per cent.

Example: 2,000 volts, 1 mile, 12½ amperes, about 500 lights,

$$R_1 = \frac{2{,}000 \times 25{,}000}{12\frac{1}{2} \times 1} = 4{,}000{,}000 \text{ ohms.}$$

The loss by leakage is .004 per cent.

Example: 2,000 volts, 10 miles, 12½ amperes, about 500 lights.

$R_1 = 400{,}000$ ohms. The loss by leakage is .04 per cent.

SECONDARY—See formula under I for direct incandescent lighting.

IV. *Multiple series systems.* Same as mains for alternating transformer system, including branches.

$$R_1 = \frac{E \times 25{,}000}{C \times L}$$

Example: 500 volts, 50 amperes, about 500 lights, 1 mile,

$$R_1 = \frac{500 \times 25{,}000}{50 \times 1} = 250{,}000 \text{ ohms.}$$

V. *Incandescent lamps on arc circuits.* The whole circuit to be tested as under II, with lamps in circuit.

MR. BADT: Now that is, in a few words, the outline of what I think would be pretty fair as a standard for insulation resistances. I have gone through all the English and American standards which have been determined so far, and I do not find anything as just as that. But I will admit now that a good many changes may be made and get the formulæ even more just than the present proposition.

MR. CUTTER: I hoped to bring something before the meeting myself this evening, but have been disappointed. I wished to bring the results of tests upon the various extra insulated wires now upon the market, as that subject, I think, is of considerable interest to us at present. We should see how well adapted they are for installations, according to any rules which we may adopt. I do not think a formula or formulæ of that sort would answer the conditions in a general way, and that they introduce considerable difficulty, not only to the inspector, but to the contractors. The tendency would probably be that a wire would be secured which would show that insulation test the first time it was measured, but less regard would be paid to the durability of the insulation than it deserved. Durability of wire insulation, under the circumstances under which it is used, is one of the principal things to be taken into consideration, and it is one of the points that an insulation test does not cover. I look upon the measurement of insulation as simply one of the many checks that we have upon our work, showing that we have done the work properly. But the thing for us to decide is, what is proper work. Now the formula itself is very difficult of application, if I understand it right, especially as applied to central station work; and I do not quite understand how the professor intends to apply this to such work; because, as I stated at the last meeting, if we apply it to the various localities of a central station plant, and then apply it to the installation as a whole, the network must have an infinite resistance in order to comply with the requirements of the formula. We will suppose an installation of 20,000 lamps, 100 volts each, to consist of 200 localities, 100 lights average. One hundred lights require, according to the formula, 22,[illegible] ohms. Dividing this by 200 gives 110 ohms as the resistance of those various localities in multiple. Then insulation resistance for 20,000 lamps, 100 volts, is 110 ohms, leaving no chance whatever but infinity in the network. Now we must cover this condition somehow or other, but of course

[illegible]

devices in [illegible]

insulation.

[illegible]

sufficient importance, considering the character of expense incurred, to comply with any such conditions. Therefore, [illegible] look to the point of danger to life and property, and they are covered by the manner in which the circuit is put up; and the various points already mentioned relating to this construction are something that we should outline.

I am not in favor of adopting a standard for insulation tests which would be so high as to block the work, but at the same time I will hail any movement which tends toward a better insulated wire than that which is so widely used in [illegible] suggestions to manufacturers of those wires, hints to the contractors that handle them, instructions to linemen that put them up, things of this sort emanating from this club, possibly first started by a committee and carefully worked out, then considered by the club, the work would not only be [illegible] the club. With this idea in view, I have thought it would be a good plan to have a technical committee of the club appointed, and refer questions to this committee from time to time, which we expect them to answer. I have thought of this question a great deal, and it has bothered me considerably, because we are all busy; and, although we stand ready to propose a committee, we do not stand ready to act upon it. But it is a question that concerns us all, especially those interested in a wholesale distribution of electric energy; and the committee thus appointed could well afford to devote some of the time during business hours to the problems put to it. I think that the company which I work for would be perfectly willing for me to spend part of that time in the consideration of problems which concern their business; I also think that would be the condition with several of the technical men of this club.

With this idea in view—and I wish to call attention to the fact that it bears upon a question now [illegible] namely, that of an exchange—I would like to say here that until a few days ago I believed an exchange to be the right thing. I have changed my opinion, and I do not think the exchange, which really means the consideration of the New England Exchange, is at all adapted to this city or to this section of the country. Our condition is different entirely from that in New England. Their cities are near together, their engineers and experts center in Boston frequently, and therefore the exchange which they have developed is getting to be quite a success. We wish to adopt a policy which is not only influential in the city of Chicago, but which will be a guiding star to the people scattered throughout this western country, many of whom will be glad to receive suggestions that would be sent forth, with the consideration which a technical committee of this society would probably give it. If we could eliminate the danger of commercial consideration of scientific questions I think such a committee would become valuable to the community and a credit to the club. With this idea in view, I move the appointment of a technical committee to consider the various technical questions which may be put to it [illegible] it being understood that they are expected to report upon those questions at early dates.

PROF. BADT: Mr. Chairman, I do not [illegible] such a committee at all. We have a rule in Chicago that the insulation resistance for incandescent circuits shall be [illegible] ohms, and for arc light circuits 1,000,000 ohms. The question was first put to a committee and then turned over to the club to decide whether these rules were [illegible]. Everybody was of the opinion that they were [illegible]. Mr. Cutter furthermore said that the equations [illegible] applied to a central station plant of [illegible] lamps. I fail to see why not. I have never seen a plant yet consisting of 20,000 or 30,000 lamps connected in multiple arc on one set of feeders. [illegible] there is such a plant in existence. [illegible] ever [illegible] a plant [illegible] that it is [illegible] in as many [illegible] as [illegible] We had a committee [illegible] the [illegible] We [illegible] [illegible]

[illegible] committee of five [illegible] insulation. Now, if we want to do anything at all, as I said last time, I am [illegible] something, let us determine something, and not dilly-dally our time with talk, talk, talk. If this policy of trifling should be pursued I [illegible] this matter what [illegible] waste my time simply talking about this thing. Let us get down to the point and say exactly what we mean. I am willing to discuss matters, but I do not want to discuss any more on this question in a general way and in this kind of manner.

MR. CUTTER: I wish the professor would show us an [illegible] installation of 20,000 lamps, so that he can put in the net work required.

PROF. BADT: As I stated before, each circuit can be measured independently. Whenever the city inspector goes into a large building wired for incandescent lights, rarely tests the whole plant connected with the dynamo. He tests each circuit by itself, and if each circuit comes up to the specifications, why it is all right. Why I can't do that with 20,000 or 100,000 lights just as well, I do not see. Suppose we have 20,000 lamps; I do not mean to say we have 20,000 lamps on one set of feeders, but you have probably twenty, thirty or forty sets of feeders. Simply test each system, and that will fall under that formula just as well. If each set of feeders, with all the lamps and branches connected with it, comes up to the regulation, that set of feeders is all right. It has nothing to do with the other set of feeders and the other lamps.

MR. SCHILLINGLAW: While I admit that Prof. Badt's idea in establishing some standard formula is proper, I, at the same time, agree with Mr. Cutter on the question of insulation. I have probably tried every known insulation in the packing houses. Where you will find one insulation that is adapted to city use you will often be unable to find a single insulation out of the entire lot of wires now on the market that will stand in a packing house one night. You may take the best workmanship, the best circuits, and put them up; your circuits to-day will measure a megohm, and a week from now they are down. There is no insulation that will stand in a packing house, and I think the club and that committee should try to establish some standard insulation, something that we can depend upon. I have yet to find it, and I do not think it can be found. The formulæ are all good, but still when you bring them down to practical use they will not hold. I have never seen any wire that is adapted to the New England trade that would stand. Packing house work is the most important work we have. There is more money in it, but I do not think you are going to get the money out of it so long as this low standard of insulation is used. I, for one, would strongly urge what Mr. Cutter has demanded, to have some committee that this question can be referred to, and also devote our time to interesting manufacturers in producing better wires.

PROF. BADT: Although Chicago is the city of packing houses, I think the number of incandescent lights in packing houses is very small, compared with the number of incandescent lights in use in other places. So far as insulation formulæ are concerned, we have one now, and the question simply is whether we shall abide by the devil we have, or whether we shall have some other devil to abide by. We certainly must have a rule. Now, this question of deterioration of wires does not cut any figure at all. I admit the insulation may measure to-day one megohm, and in a month from to-day may measure rather below that. We may test a boiler for a certain pressure, and maybe four weeks from now the boiler will burst with the pressure it was tested by. Still we have got to test things in order to get an approximate idea of what they will stand. Suppose we fail to test wire—say that we will use the best wire we can buy and see that we get better wire all the time, and, after being furnished with the best wire we can get, say that is all we can do and that it will serve every purpose—that may be all very well, but fire underwriters will not be [illegible]. We want to have something tangible. There is nothing tangible in such a proposition at all. We must have a certain rule, whether that rule is good or bad. It may be bad, but for all that it is certainly better than nothing, because it will compel the people who put up installations to do a little more than they would do otherwise [illegible] competition. We all know what the tendency is. They all want to put up plants as cheaply as [illegible], for we all want to make money. Yet we ought to be compelled by somebody to do [illegible]. Now, the companies in England, in France, and in the United States, have determined [illegible] in putting up plants. [illegible] gentlemen who got [illegible] [illegible] insulation for [illegible] put up a good [illegible]

[illegible] but that we ought [illegible]

could get together to pass upon these things and, although perhaps we cannot attain perfection, we can help on in the good cause, we can select something that is good, something that is the best always. In so far work will be done that is of value. Now, I wish to be understood as favoring this formula by all means, because I think it is a step in advance, one step nearer something which we all need; and it is something that will be more just to each one of us, but especially to the arc lighting system.

MR CUTTER: The reason I thought of the technical committee was because of my disappointment in being unable to furnish the data I wished to bring before the club, that we might avoid the very thing that the professor is complaining of—too much time consumed in general considerations and failure to drive the nail home. We cannot drive the nail home unless we know how to do it. I claim that the formula is worse than that we now have. I fail to understand, if the requirements of the insulation of an arc light circuit of one megohm for all arc light circuits is unjust to any party, why a formula which increases that insulation to $2\frac{1}{2}$ megohms, is any more just. And it is all to be determined by what? Data given by the company and assumed to be correct by the inspector. It will be astonishing how long circuits we will put in. If I put in a circuit of a mile, and my conscience is elastic enough, I will call it five miles if necessary in order to secure a certificate. The application of the formula is something that renders it absolutely useless, and you would not have it in operation a week, or you would not try to work it a week, before you would want to call a meeting to know what to do. Now, what is the use of jumping from the frying pan into the fire because we do not want to lose time? I thought of the committee because that I felt if I were on the committee I could drop Prof. Badt a note as a member of the committee, possibly, and say, "I think of doing so and so. What do you think of such a suggestion?" He would answer it, and the interests of the company that he is with, or if he is in business for himself, his own interests would not only warrant his taking the time to communicate with me, but also his coming to the club to meet members of that committee. I would like to change the number of that committee to seven or even nine, so that we may always get some of them here; enough of us to consider the questions which may be brought up. It is not necessary that that committee should come here and talk in a general way upon the technical questions put to them. The chairman of that committee could communicate with the various members, and learn from them which one or ones could handle any particular question. It may be, for instance, the insulation tests of the circuits, one of the most difficult questions of the whole lot. It is far-reaching in its benefits, and we don't want to change it all of a sudden and be worse off than we are to-day. That question can be handled by one, two or three members of the committee; answered by catching a moment when you can to measure this wire, to test that, or try this experiment or that; and in that way they could enlarge their ideas, meet once in a while at lunch, or something of that sort, and discuss the questions, and the result would be that they could furnish information of value. I might proncunce my opinion upon some particular insulated wire. I experiment with it to see the effects of heating. I put it into water and get it as cold as possible, bend it back and forth several times, and then measure the insulation. That is the kind of data that we want, and that is the kind of data that the manufacturers of those wires want. Manufacturers make a first class insulation, and it goes to the storehouses of the different companies, and where do you find it?—coiled up in a haphazard sort of manner by a man that knows nothing about insulation; coiled up and hung over a pin, and if he wants a little of it he will pull on that pin, wearing into the insulation all the time. He sells it to the different people that are handling these wires, and they have lots of trouble. They take that wire, supposing that it is good as it comes from the manufacturer, and they stick it into the wall; and they have got to do more work to remedy the difficulty than to put in the work originally. This is work that can be brought before the club for consideration, and suggestions can be made by the club. The testing of our installations in Chicago has done good work for the last five years, and it is doing good work to day. Some people may feel that it is an injustice; I do not. I feel that it is handled in pretty good shape, and will take care of us until we are ready to go before the city with a recommendation that is backed up by the proper kind of tests, and the proper kind of data. Not by considerations of a formula that one technical man says covers the conditions and the other technical man says is of no value; for when the technical men disagree, who is going to decide the question? It is because we do not have the right kind of data that I advocate the committee, and I want that committee to come before us to advance something that will be of value.

MR. SCHILLINGLAW: I will say Mr. Badt is correct in regard to electric lights in packing houses, and that matter [illegible]. The simple fact is that simply they are adopting a standard rule laid down by the electric light companies some time ago as to what was good insulation and what was [illegible] proper to use in wet places, for all kinds of [illegible] has been done. In using these different wires we have [illegible] of increasing the plants, decreased them. Some houses threw them out entirely, and where [illegible] now, you might have two or [illegible] lights, for the simple reason that [illegible] the wires. Now, it [illegible] to have a standard, [illegible] where you are [illegible]. We find some wire that is good, [illegible] I am highly in favor [illegible]

not the amount of insulation that you have got, but it is the quality of the insulation, which will stand sawdust and steam, and so on. We want to have that committee, and at the same time adopt the suggestion of the professor, and if we can make practical suggestions to the manufacturers we can increase our business and act intelligently. I doubt whether there is any insulation now in use in the packing houses that would carry out the measurements [illegible] thirty days, and I think the professor will carry me out in that.

PROF. BADT: No, I will not. The insulation resistance of a plant when measured does not represent, by any means, the good or bad quality of the insulation of the wire. We all know that we can put up bare copper wire with glass insulators, and if we have a few good insulating supports, our installation has a higher insulation than that assumed in any of these formulæ. If we put up a wire in the packing house, I do not believe there is any insulation which will withstand the action of all these influences mentioned. The only way to do in such places, is to use good insulating supports—in fact, I have seen the so-called underwriters' wire put up on glass insulators (not insulators put up upside down, but in the proper way) give the insulation resistance required. I grant that under certain circumstances even insulation of that kind will not stand the effect of steam condensing on the insulators and so on, but still no trouble will arise from such a plant. I put up the other day a plant in a very bad place, in a foundry, and the wires were the wonderful underwriters'; it was a high tension arc light plant; glass insulators, and everything was covered in a few hours with dust and dirt and smoke and steam, and the insulation on that plant measured way over a megohm. That shows, of course, that good judgment must be used. We all know that the test of a plant does not depend for its insulation resistance as much on the insulation of the wire itself, as on the insulation of its supports. If those supports are good, we will get a high insulation, while the best insulated wire if put up on poor supports, will show little insulation resistance in places of that kind. The point I want to make is simply this: The formulæ refer to the insulation resistance of the plant and not to the insulation resistance of the wire only. You must not think it is the same thing by any means. The insulation resistance of the plant depends a great deal, I admit, upon the insulation of the wire in the first place, but in the second place, upon the way the wire is fastened, and there is where judgment comes in to a very great extent. We cannot fasten a wire in a dry place in the same manner as required for a damp place, and so on. In the third place, I will mention that the most critical point is when we make joints; we have to be here more particular than in the two other points. So the idea in measuring the insulation resistance of the whole plant is not to measure only the insulation resistance of the wire, but to get a very fair idea of the character of workmanship and other things besides. What we want to test by these formulæ is the insulation resistance of the whole plant, and we want to get an idea of how the plant is erected. The inspector cannot crawl into each hole; all he can do is to measure the insulation resistance and inspect the plant generally, and so approximately get at the kind of wire that is used, workmanship, etc.

MR. THOMPSON: As most of the members probably know, the first man-of-war that was ever wired was the United States steamer "Trenton." At that time I had a little something to do with the settlement of the specifications for that ship. The contract was awarded to the Edison company, and a certain set of specifications were drawn. We passed the specifications for the wire and for the insulation resistance, but there were certain requirements made for the lighting of ships, and there was a most tremendous opposition. The contractors said, "We cannot bind ourselves to any rule." Well, the result was that there had not been enough experience in ship wiring for the naval authorities to take any decided stand, and they let the Edison company do it their own way. The result was that, although they did a very good piece of work, still the insulation of the wire would not stand, and the wire was all taken out when the ship came back from her first cruise, and was replaced. The result was that when the next contract was let for electric lighting on the "Chicago," the "Atlantic" and the "Boston," the government presented an elaborate set of rules which called for a high insulation resistance. They called for a large area of copper, and a large carrying capacity of wire. They specified the dielectric, they specified every single feature. The companies found the greatest fault with those specifications. "Oh, we could not come up to that; we could not do this, and we could not do that." "Very well, then, you need not make bids." But they all put in their bids, I noticed, just the same. The Edison company got one ship, the Brush got another, and the United States got a third. They put the plants in according to the United States rule, and to-day there are three systems of electric lighting on ships that are giving perfect satisfaction. Now, we have heard something about packing house work. Of course, on board ship you can find every sort of difficulties to overcome. You will find salt water, you will find steam, you will find gases arising from the bilge, eating into the insulation and destroying it. We have got to have the best available experience to decide upon the thickness of the dielectric, the insulation resistance for the plant, because if you put in a plant for the government you have to come up to its standard. The result is, it has good work. I want somebody to show me the injustice of this new rule that Prof. Badt has suggested. I have just been working out a few little problems myself. Why is it that an arc light circuit, say ten miles in length, should have the same insulation resistance as one a half a mile, or why is it that a 1,000 light incandescent plant should be expected to show the same insulation resistance that one of 100 lights does? It seems to me that this is a matter of a great deal of importance to each member here who is connected with contracting companies. I think Prof. Badt's [illegible]. Now so far as to what [illegible] that [illegible] question that come up [illegible]. Let one agreement be made upon what [illegible]

ance may vary for them. They may make what they please for incandescent work. They may make what they please for arc light work, and they may make what they please for alternating current work. There is one thing very certain, that on short line work, the current will always have a much higher resistance than on a longer one. There would be about as much sense in saying that no rule should be adopted, as to say to these cable street car companies, that because it is hard work for them to keep their insulation in their cables that they should be allowed to follow out their own best judgment. In every other kind of electric work, in cable work and everything else, you will find that certain standards are fixed, and those standards have been arrived at by a long number of experiments. So far as this Chicago rule is concerned, I can't exactly say what effect it has. Take an Edison central station plant and place it in a building, and we make a rule for that, and they apply the same rule to a small plant of 100 lights. It would be preposterous to expect the same results. While the wire of the small plant would show an enormous insulation of resistance, take one of the feeders, perhaps it may have a bug in it, and it would not show near as high. But yet both would work perfectly satisfactorily. I think the same rule should be adopted, and if it were worth while for the government to make strict rules, why wont it work for the electric light people here, when they have a chance to make rules that are reasonable, and still rules that will insure good work, and help to give suggestions, both to the contractor and to the party that is having the plant put in?

THE CHAIRMAN: I would like to make a remark in explanation of the subject. All this electric light business is like a horse that has got away without a saddle; it has started to run away. Everything in the shape of laws, rules and regulations that were made in the early days, were made by persons who had the crudest knowledge of electric lighting, or what it was to be. No man six years ago had any idea of a circuit that would ever be more than a mile long. During the early days electric light men who could run a circuit for a mile and put lights on it, did remarkably well. A megohm to the mile was perhaps the original idea with those rules which were originated by the underwriters. From that same source of ignorance we get this abominable wire which we now have. An underwriter does not know anything but fire, and he does not care for anything else. You cannot make him understand that water will produce fire. He is interested in the fire department, and they use water, and they use it to fight fire with. He knows that fire will burn and water will put it out, and that is about the extent of the knowledge he has. We subsequently adopted the underwriters' wire which we have been trying so hard to get rid of. These rules with regard to insulation came from the same general want of knowledge of what we now consider the laws of electric lighting.

MR. CUTTER: Suppose two business blocks have 1,000 lights each, on the supposition that 500 amperes at 100 volts will supply them. Each installation would require according to the formula 5,000 ohms. These, I believe, are the professor's figures. Now, I start with a scheme to supply those lights from a central station two or three blocks away, and I run my wires to the two business blocks. You require an infinite resistance in the connection wires in order to maintain the conditions of the formula. The two blocks in multiple would give an insulation of 2,500 ohms. Two thousand lamps according to the formula require 2,500 ohms, leaving nothing but infinity, as I said before, for the network. The formula is utterly useless for installations like the Chicago Edison company. It does not answer the question of what we will do with the street work. We simply go from house to house and measure the insulation in the honse, according to data given by the contractor as already mentioned, which is a point of considerable force, because the inspector is dependent upon that data. Of course they are going to make it out in many cases that they have a very large installation. They put in the wire works, perhaps, for a good many thousand lamps, but they only put up 1,000 lamps to-day, and will operate them for a long while; they put them in with the same resistance as though it was for 5,000, and they will say that is what the installation was made for unless the inspector bothers himself to find the contract and look into the matter. Every business man knows how that is done.

PROFESSOR BADT: No, he won't do that. He has got to pay for it.

MR. CUTTER: Of course he has got to pay for it. That is one check. There is another feature of the problem: We have had a limit in incandescent work of 100,000 ohms, and in arc work one megohm. Has that standard had anything whatever to do with the quality of insulation used on our wires?

PROF. BADT: Yes, sir.

MR. CUTTER: I think it is the work of the inspector, and not the formula. The first good stroke was when we tabooed underwriters' wire.

MR. THOMPSON: I would like to ask Mr. Cutter to explain, whether it would not be a little bit easier to get 5,000 ohms insulation in the first two feeders, the first 1,000 lights, than it would be to get 100,000 according to the professor's rule. It seems to me between 100,000 ohms and 5,000 we gain almost 95,000, or in that neighborhood. I want to find out what is the matter with that.

MR. CUTTER: Then why do you put forth a formula in which you have got to adopt some other standard for that installation?

PROF. BADT: This question is so very important that I think it should be discussed before the whole club until we get through with it. There are quite a number of gentlemen absent who have not been heard from on this subject, and I am afraid the chairman will make a mistake and not appoint those gentlemen upon the committee. They might say something on this question yet, and I think it would be the best thing to have such an important question discussed here in the club to elicit more information and better ideas. As Mr. Thompson said, I do not mean to say that my formulas are perfect. I think I said that before, when showing these equations on the blackboard, that they are very far from being perfect. But I think they are as much ahead of the rule that we have now, as the science of [illegible] higher [illegible] together, and [illegible] here [illegible].

The [illegible] to [illegible] the [illegible] insulation.

CORRESPONDENCE

New York Notes.

NEW YORK, Jan. 12.—The prevailing topic [illegible] in electrical circles is the electric [illegible] swindle. [illegible] Roberts[illegible] mitting it to the investors here he will go to England for the same purpose. He also says that President [illegible] soon be here to answer every charge that can [illegible] against him. As a matter of fact, Mr. Cotterill is out west, and Mrs. [illegible], the wife of the [illegible] process, is "ever the better," and we have [illegible] the lamentable [illegible] of a story of extraordinary credulity. It is satisfactory to note that, save in name, [illegible] played no part whatever in the perpetration of the swindle. The public has not failed to note the resemblance [illegible] the main features of this scheme and that of the Keely motor, and its exposure may very possibly bring about a culmination of the efforts of the astute Keely to keep from the world a secret that his shareholders have paid so dearly for not knowing.

Mayor Grant has sent his first message to the board of aldermen. It presents a statement of the city's financial condition, and dwells at some length on the topics of rapid transit, better pavements, improved water front, new municipal buildings, and the parks, schools and other minor matters. With regard to the subways, the mayor says: "Notwithstanding the general demand for the burial of electric wires, and for the removal of the poles which disfigure our streets, the nuisance remains unabated. Laws have been enacted which were intended to afford the city relief from this imposition, but either on account of imperfections in the law, or remissness of the officers charged with its execution, the poles and wires continue to obstruct our thoroughfares. All the provisions of the existing law will be invoked to remedy this evil, and if they prove inadequate we should ask the legislature for additional powers." There is no doubt that the accession to the office of a mayor who is willing to work with the commissioners of the Board of Electrical Control, and the recent refusal of Judge Lawrence to grant to the United States Illuminating company an injunction against the commissioners, will place the board in a stronger position than it has yet held, and it is possible that its operations will be followed by material results.

The big Edison consolidation begins to assume more definite shape, and in all probability it will go through pretty much under the conditions already made public. It is believed that under the title of the Edison General Electric company it will not only do a gigantic business in this country, but will also enter into affiliations with European concerns, and special and extensive operations in Germany are contemplated. It is a matter of satisfaction to know that Mr. Edison's influence will in no way be lessened by this combination, and that the practical work at Orange is to be carried on with even more than its former activity.

At the session of the Board of Trade and Transportation, on the 9th inst., a bill was recommended that is likely to meet with lively opposition by the telephone companies. It provides that all companies, firms and individuals, incorporated and unincorporated, which are engaged in supplying telephone communication in cities and incorporated villages of the state, shall furnish to each subscriber within its district the necessary apparatus, "in cities of 500,000 inhabitants or over, at and for a charge and price of not to exceed $6 per month for such service, and in all other cities and incorporated villages of this state at and for a charge and price of not to exceed $3 per month." Section 2 provides that any corporation or individual affected by this act, or any officer, agent or employe, who shall wilfully violate any of its provisions, shall be guilty of a misdemeanor, and also be liable in a civil action for damages by the person aggrieved, and "any such person or company violating any of the provisions shall also be liable in the sum of not less than $50, nor more than $500, in the discretion of the court, for each offence, recoverable at the suit of the people on the relation of the attorney-general, who shall bring an action for the same in behalf of the people of the state of New York, and the amount recoverable in such action shall be paid one-half to the state treasurer, and one-half to the county treasurer in the county where such action may be brought."

A novel discovery is reported as having been made by a [illegible]

[illegible] in view [illegible] F.

St Louis, Mo.

[illegible]

The council committee on railroads has taken hold [illegible] energetically of the elevated electric railroad bill introduced in the council recently, the route of which will enhance the value of Seventh street property, from Arsenal to Palm street. The bill now before the committee describes the proposed road and rates as follows: The Electric Elevated Passenger railway shall consist of a double track line, which shall begin at the west side of Grand avenue [illegible] street, and run east on Arsenal street to Seventh, Broadway and Palm streets, Prairie avenue, Maffit avenue, Union avenue, Wabash street, Cass avenue, Hunt avenue, Vandeventer avenue, Magnolia avenue, Tower Grove park to Arsenal street. The fares to be charged are as follows: Between 5:30 A. M. and 8 A. M. and 5 P. M. and 7 P. M., 5 [illegible] between 8 A. M. and 5 P. M. and 7 P. M. and [illegible] cents; tickets for children under 12 years of age, at one-half the foregoing rates. In consideration of the franchises granted for fifty years, the Electric Elevated Railway & Power company agrees to pay to the city of St Louis, beginning two years after the construction of the road, 3 per cent. on its gross earnings for each six months for five years, and 5 per cent. thereafter. The amounts are in addition to all other taxes prescribed by law; and the failure of the company to file a semi-annual statement and pay the sums agreed upon within thirty days after they become due, shall work a forfeiture of the franchise. The incorporators ask permission to carry electric wires. The rate of speed, it is agreed, shall not exceed twenty miles an hour. The committee last week drove over the proposed route. Seventh street and Broadway were the only portions of the route that were objected to in the least by the [illegible] on account of the large amount of traffic and business on the thoroughfares. Palm street is ungraded and has no sidewalks on its entire length, and is very thinly built up, while the same can be said of the streets on the [illegible] portion of the route. In the opinion of the members of the railroad committee, all property along the route, except, perhaps, that on Seventh street and Broadway, would be materially benefited by an electric elevated road, and the report of the committee to the council will [illegible]. The committeemen, in regard to the Seventh street and Broadway property, are somewhat [illegible] take the position that the many should not [illegible] suffer for want of rapid transit for the sake of the few [illegible] all agree in the statement that an elevated [illegible] some nature should be speedily passed. The company seeking to obtain the franchise consists of [illegible] J. Fisher, Charles Suter, David [illegible] O'Meara, George F. Branham and [illegible]. The general opinion prevails among members of the [illegible] assembly that an elevated road should [illegible] though none of them will say whether [illegible] the present one [illegible].

In both branches of the [illegible] what shall be [illegible] measures. Last week [illegible] Stone, Hays, Hoener, M[illegible] recommend[illegible] of the [illegible] of [illegible]

tersection of the two streets, and on top they terminate in a [illegible] feet wide. The [illegible] towers [illegible] the condition that the suspension [illegible] steel [illegible] between the towers should [illegible] uppermost win- [illegible] will be [illegible] along the street on which the towers are to be placed. [illegible] feet [illegible] to 120 [illegible] feet in the business part of the city. The towers are placed at such distances apart as will be most economical, either one, two, three, or four blocks. The steel wire suspension cables, by which the weight of the electric wires and cables is to be supported between the towers, are never less than two in number. The two cables [illegible] parallel and have the same elevation throughout the whole length of the span. The horizontal distance between the two cables is generally from eight to ten feet. At short distances apart, above every twenty five feet, measured horizontally, the two suspension cables are connected by a stiff bar, or pipe, which will hold the proper distance apart when the wheels of a truck pass over it, or when the wind tends to produce oscillation of the cables. On these cross-bars, or tubes, are carried the electric cables and wires resting on proper supports. At the center of each cross-bar, or tube, on all lines consisting of but two suspension cables, a vertical strut is attached to the lower side of the cross-bar, and from the lower end of this short strut iron tension rods pass to the ends of the cross-bar, or tube. The lower ends of the struts, attached to all the cross-bars, may be connected by a small wire, to keep them in a vertical position under the effect of the high winds. When a conducting wire is to be carried from the cross-bar to a house, it is first attached to the bottom of the strut, and thence to the house. Lines with only two suspension cables are used when the number of electric wires and cables to be supported is small, and may be designated as auxiliary lines. On lines which have to accommodate a greater number of wires, a third steel wire suspension cable is added. To the ends of the cross-bars iron frames are fixed, and instead of the short struts used in the auxiliary lines a long strut is used, extending from the center of the cross-beam to the lowest point of the frame, and there strongly connected with it. At the lowest point of the frame a fork is fixed, in which the third suspension cable can move freely up and down, while it is held by it against lateral motion. The frames carry, at short distances apart, insulators, to which single wires can be attached. When a wire is to be taken to a house the single wire is led from its insulator on the side of the iron frame to the third cable, and thence, after having been attached to that cable, carried to the house, so that it shall not be in the way of the traveling truck. When the capacity of the line is to be still further increased, which will be necessary in but few cases, two more suspension cables are fastened to the towers and stretched parallel to, and directly under, the two [illegible] that they are about on a level with the lower ends of the iron frames. These two suspension cables are connected by cross-bars. To enable the linemen to place and repair the wires and [illegible] with houses, it is intended to use trucks with four wheels, supporting a light platform. [illegible]

running time on the road with the electric power will be reduced nearly one-half.

The employes of the Bell Telephone company will give a ball at Natatorium hall on January [illegible]

Kansas City, Mo.

KANSAS CITY, MO., Jan. 12.—The council held its first meeting of the new year last week, and spent much time in the discussion of the movement to lower telephone rates. The council committee reported that municipal legislation would be unavailing. The committee thought the present prices unjust, and in many instances the charges not uniform, and the only relief that it believed could be obtained was through the state legislature. A resolution was adopted instructing City Counselor Quarles to draw up a petition memorializing the legislature to pass a bill reducing telephone rates. Dr. E. B. Lewis made a brief statement of the efforts of the physicians to reduce prices, and said that they would be glad to have the indorsement of the council. Nothing was done regarding this, but the committee of physicians will make a more elaborate statement before the telephone committee.

J. R. Mulvane, president of the telephone company, has sent a communication to the mayor and council, in the course of which he says: "You are asked to assume that our telephone rates are exorbitant, and to demand rates that mean bankruptcy and ruin our company, a large interest in your growing city. Kansas City enjoys to-day the best and quickest telephone service in the United States at much the lowest prices of any equally sized city in the United States. In addition thereto, it is an established fact that the use of the telephone per subscriber is 25 per cent in excess of cities of 50 per cent. greater population, and all this is at an increased cost of operating expense to the company. Your bank clearings are much greater proportionately to your population than any city in the United States. This same activity is shown in the use of your telephones, while the rates charged in Kansas City are much lower, as the following comparison will show, within the usual three-quarter mile radius from the central offices:

New York City, express and legal	$210	
New York City, business	150	$150
New York City, residence	75	100
Philadelphia, business	120	
Philadelphia, residence	100	
Boston, bank and express	120	
Pittsburg, business	84	100
Boston, business	96	120
Cincinnati, business	72	100
Louisville, Ky., business	72	96
Chicago, business	100	125
St. Louis, business	100	
New Orleans, business	96	
Denver, Col., business	80	
San Francisco, toll for conversations	60	
Kansas City	72	

"This charge we increase at the rate of $6 for each quarter of a mile additional distance from the central office. No advance in price has ever been thought of, but we live in hope of the expiration of the patents, when the royalties now paid will be off, and give relief to both the telephone company and our patrons. Our rates are the same on all business telephones that they were when the exchange had only 500 subscribers, while to-day we serve 2,500 subscribers. This greatly increased facility has been at an increased cost of plant, and an increased cost of maintenance. We as a company are poor, and are burdened with royalties, which must be paid or we must quit the use of other people's property, yet we in our poverty have tried to serve all applicants, the far away ones, on long lines at a loss.

"The rapid growth of the city has made our work expensive, and we have had to pay our part of the high rents and high wages, and stand the constant removal of lines, [illegible]

The United Telephone company was organized in April, 1883, with a capital of ... 70[illegible]

Total	$1,70[illegible]
Of which the United Telephone company [illegible] in the treasury unissued	2[illegible]
Total capital stock paid for and issued by the two companies	$1,450,000

The Missouri & Kansas Telephone company of Kansas is [illegible] at a nominal rental, and for the payment of debts to the amount of $250,000.

New stock issued in reorganization at par	$ 250,000
Joint capital stock	1,450,000
Total	$1,700,000
Reorganized company's stock	$1,250,000
Net loss to stockholders of	$ 450,000

A stock dividend of $79,585 was paid to the stockholders, at par, in lieu of cash earnings used to pay debts. The average per cent. of cash dividends is not quite 2 per cent. per annum. Average per cent. of all dividends $2\frac{1}{4}$ (not quite). The highest dividend paid was in 1887, and was at six (6) per cent. The lowest dividend paid was for the years 1884 and 1885, and one-half of 1886, when no dividend was declared. The rate we hope to pay is 6 per cent. annually. The rate paid in 1888 was $1\frac{1}{2}$ per cent. quarterly. Three-quarters have been paid, making the rate $4\frac{1}{2}$ per cent. The dividend for the fourth quarter of 1888 will probably be paid by the sleet storm of December 25th and 26th. The market price of Missouri and Kansas stock is now 70 to 75. For a fully paid stock, without a semblance of water, this price does not presume that large profits are in the business, and this rate of dividends does not indicate an oppressive price to our subscribers. Nor that our monopoly has been used to the damage of any citizen. We have paid our debts, but not grown rich. Our plant is in the meantime worn out. We know of none who have done so poorly, and we can only pride ourselves with the satisfaction of giving the most service ever given, per subscriber, at the cheapest rate per subscriber. We have earned and paid for 1888 three dividends of $1\frac{1}{2}$ per cent., making a total of $4\frac{1}{2}$ for the three quarters of 1888. Our fourth we got Christmas night in a disastrous loss, that will cost us $18,000 to $20,000 to repair. That storm has developed weaknesses in our plant that will demand before another winter perhaps $50,000 more expenditure. We have kept an army of men and women in employment at good wages. Our capital has been invested in your city, and we are in your hands. We ask only even-handed justice. Your policy has been to invite capital, and invested capital has built up your immense city. If we are ruined and bankrupted, the question to capital is, who next? What other business interest that has come to your city with the hope of future harvest that has not done better? Our stockholders are all over the country that has so lavishly poured her wealth into Kansas City. You have the fatal example of Indianapolis before you, not one telephone in use where there were three in said city, and the service an excuse. You cannot afford to wipe out or cripple this efficient aid to your business men. We do not believe your business men want their telephone service lessened in the least, but that to the busy business man the better the service the more useful to him. And your city cannot well do without an efficient, prompt telephone service. We invite the fullest investigation and ask your honorable body to appoint a committee to investigate the facts. For that purpose our business affairs and books are at your service."

Twelve hundred names are attached to the memorial to the legislature for the regulation of telephone rates, which the Kansas City Telephone league drew up at the Midland last week.

[illegible] petitions are now in circulation in this city praying the Missouri legislature to pass a bill at this session regulating telephone rates. The bill has been prepared by Senator [illegible], of St. Louis. Following is an extract:

The annual charge for the use of the telephone in all cities in Missouri having 100,000 inhabitants or more shall not exceed $[illegible] [illegible] [illegible]

[illegible]

operation again. The storm disconnected 1,500 telephones.

The Kansas City Electric Light company [illegible] rangements with the Exposition company [illegible] dynamos and plant at the Exposition [illegible] the plant of the [illegible] ties of the Kansas City company [illegible] fully accommodate the East side and [illegible] plant at the Exposition building is expected to supply [illegible] ready 250 lights have been switched [illegible] circuit and 3,000 can be supplied.

THE ELECTRIC LIGHT.

The citizens of Weatherford, Tex., are raising the money to place six arc lights over the court house [illegible]

The Western Electric company's 250 light addition to the plant at Toledo, O., was successfully started last week.

The American Heat, Power & Light company of Chicago has been incorporated; capital stock, $100,000; incorporators, Jesse Cox, William M. Stanley and Adolph Fisc[illegible]

The Western Electric company will install a 50 light incandescent plant in David Oliver's hall, at Joliet, Ill. The dynamo is of the Western Electric company's make.

The Woodward Electrical company of Detroit have installed in the E. W. Voight brewery, Detroit, fifty-seven cells, which furnish current for 100 16-candle power lamps for lighting the brewery and Mr. Voight's residence.

Among the recent sales of the Thomson-Houston company are the following: Nelsonville, O., 50 arc and 500 incandescent alternating, new installation; Trinidad, Colo., 35 arc and 1,200 incandescent alternating, increase on original plant

Santa Cruz recently installed an electric light plant of 81 lights. The cost of operation is $450 per month, and as the city receives $330 from subscribers, it costs but $120 per month, or less than $3 each, for the 42 lamps used for public lighting.

The Rogers Park Water company of Chicago has been incorporated. The capital stock is $50,000. The company will furnish water for Rogers Park, and electricity for light and power The incorporators are H. E. Keeler, F. D. Keeler and N. A. Partridge.

A London correspondent writes that the Metropolitan Electrical Supply company of London is putting up a 3,000-light incandescent plant of Westinghouse company's apparatus. The central station will be on Oxford street in the northwestern part of the city.

The Keystone Construction company of Pittsburg, represented by E. E. Keller, at 156 and 158 Lake street, Chicago, has just finished a 650 light installation at Joliet, and is now engaged in installing a plant of 750 lights for the Fremont Gas company.

Seventy-eight Brush storage cells have been installed in the dynamo room at Cornell university, Ithaca, N. Y., to light the offices of the professors in Sibley hall, to furnish light for evening work in a portion of the carpenter shop, and to light the wheel and gorge.

S. J. M. Bear of Chicago, in a communication to a daily paper, says he has invented a new form of dynamo which will possess twice the capacity of the ordinary generator. Here is one claim which he makes of his machine: "As more glow lamps are paralleled in circuit the applied power is lessened, resulting in more light from less coal."

A party of capitalists will, at Sherman Tex., make the city a proposition to purchase the electric light plant at the next meeting of the city council. The representative of a Philadelphia manufactory is trying to organize a local incandescent electric light company in the same place

The Electric Light company of North Topeka, Kan., expects to have its building completed in a short time. The walls of the addition are now up, and the large boiler in place. The masonry to support the dynamo engine in the main building is now being built, and as soon as finished, the machinery will be put in place.

The newspapers of Rochester are advocating an underground conduit for all electrical wires. The wires of the Edison company are buried in the center of the city, but the arc lamp wires are still overhead. A few days ago a wire stretched across a business street so sagged under the weight of sleet upon it that it caught a street car going north under full headway, under the forward projection of its roof, and brought it up standing.

A new miner's lamp has just been brought out in England. A secondary battery with lithanode cell is employed. It is said the weight is much less than that of previous cells used for the purpose. The battery consists of two cells giving 4 volts, and it weighs complete with the lamp, 5 pounds The charge is said to be sufficient to maintain a light of one candle for twelve hours, the charging time being five hours. The lamp itself is protected by a cover made of toughened glass, and so shaped as to hold up a switch lever, by which the circuit from the cells through the lamp is maintained. Should, however, the glass cover be broken, it will immediately fly to pieces and allow the lever to fall, thus extinguishing the lamp before the lamp itself is broken. This provision has been adopted to guard against ignition of fire damp from the red hot filament of the lamp. The cover is locked with a lead plug, and ordinarily cannot be switched out by the miner, but is taken down and brought back alight. Should, however, through some accident, a miner be detained in the working, he can pick the lead plug with his pocket knife, take off the cover and switch the lamp off, so that he may by this means economize the light. The lamp will not go out if turned

[illegible] [illegible] Wh[illegible] [illegible] and the [illegible]

[illegible] M[illegible] Martin, president of the [illegible] New [illegible] completed the purchase of property for the erection of a [illegible] Westinghouse [illegible] Mr. M[illegible] states that the [illegible] the property has been purchased [illegible] H[illegible] [illegible] the [illegible]

A Washington telegram says: "The lighthouse board has recommended to congress that $50,000 be appropriated to establish lighthouses and steam fog signals [illegible] end of the [illegible] breakwater at the harbor [illegible] [illegible] regard to the completion of the breakwater. It is proposed by the lighthouse board to have the wa[illegible] Chicago harbor lighted by electric lights situated on high poles on the shore of the lake nearest the crib."

THE ELECTRIC MOTOR.

The presses of the *Iowa State Register* of Des Moines are operated by electricity. That paper says it is a good, safe and cheap power.

The tone of the Peoria newspapers indicates that the people of that place are dissatisfied with slow-going horse cars, and would welcome the introduction of an electric street railway.

The proposed third track on the elevated roads of New York city, upon which to run express trains from the battery to Harlem, would give a magnificent opportunity to show what can be done with electric motors operating large trains of cars for trips of several miles, says an exchange.

The Julien company, anticipating the action of the New York aldermen in granting the franchise for the Fourth avenue electric road, have a number of cars already completed, and in a few days they will have twelve cars operating on this road, it is said. S. M. Young, when questioned about the statement that the batteries magnetize watches of passengers, said: "No; it is absurd. They do not in the least affect timepieces. See this watch. I have carried it on the electric cars repeatedly, and it is all right. It is true that the watches are magnetized when brought in proximity to large dynamos, but I never heard of their being affected at all by cell batteries."

A Nashville (Tenn.) paper says: "The much talked of operation of street cars by means of electricity is now a certainty for Nashville. The McGavock & Mt. Vernon Horse Car company is to be the first to undertake this new enterprise in this city. For some days past H. N. Curtis, the New York representative of the Thomson-Houston company, has been in the city conferring with the street car company officials, and yesterday afternoon a contract was made and signed with him for the operation of the company's cars by his system. The contract calls for the completion of the work on the Vanderbilt line by April 15th. Cars operated by electricity will make the run from the stables to the end of the line in twenty minutes. The company has ordered six sixteen foot cars to be used on the Vanderbilt line."

The Woodward Electrical company is completing a storage battery outfit for a street car to be operated in Detroit. A representative of the company says: "We have just received an order from the Coney Island Street Car company, ordering a large number of our batteries We are going to show the Western Union Telegraph company, the telephone companies and others, how much cheaper our storage system is than the system they use now. We are using it on railroad trains for signals connected with the Parrish bell cord, electric lights on steam boats, motors, etc. Besides that, I am going to build an electric locomotive this winter—full sized one, large enough to haul a train of cars. I have my papers made out, application in for a patent, and will have the working drawings out next week. I have engaged an electrician from Chicago to supervise the work. Of course, our battery is going to be used, and the engine be run cheaper than with coal."

In reply to statements of Manager Currie of the Detroit Street Car company, General Manager Trout of the Woodward Electrical company says: "In the first place Mr. Currie says that the storage battery system is a failure [illegible] that the weight of the battery would necessitate new tracks that the battery has to be renewed every two years or less, and that it costs $2,500 to equip a car. In the first place the storage battery system is a proved success on the Fourth avenue line in New York city and also on the Atlantic avenue line in Brooklyn. The board of aldermen of New York have voted to grant the privilege of using the storage battery system on the Fourth avenue line, which has been in successful operation for the past six months by that device. In Brooklyn two cars have been successfully propelled by the storage system for the past three months on Atlantic avenue. In regard to the statement that the storage batteries are so heavy that they need special new tracks, I would simply say that it is not correct. They use the same track and the same cars as those now in use on the horse car lines. A series of cells necessary to propel a car sixty

[illegible]

THE TELEGRAPH.

[illegible]

each, upon which he has paid, it [illegible] [illegible] this city. The old company was indebted to the amount of $[illegible] unpaid amounts on the capital stock."

[illegible] who make regular inspections of the lines and test the [illegible] "stick" in New York the other day, was accosted by a reporter [illegible] "I [illegible] long this stick will stand up," he said, twisting the handle [illegible] pole and it is my business to go about the streets making inspections like this. Every pole is numbered, and when I make my report the company takes action according to the condition of the wood. This is the only way we can tell how strong a pole is, for decay begins beneath the surface and works toward the center. It shows on the outside last. So you can't tell by the looks whether a pole may not come down in the first high wind, or light one, either, for that matter. This one," and he withdrew his gimlet and looked at the fine shavings [illegible] a year without danger. There is one on the Bowery, near Fourth street, that looks perfectly sound, much better than this one in fact, and yet it is decayed almost from surface to surface, and is liable to tumble any day."

Concerning the new telegraph line which the Chicago Postal Telegraph company is building north from Milwaukee, I. McMichael, the Western Union superintendent who has charge of the district, including Northern Wisconsin and Michigan, has issued a circular from his office at Minneapolis informing agents of the Western [illegible] representatives of the Postal company are soliciting subscriptions for their scrip, to be paid for in telegraph service at lower rates than those charged by the Western Union. To offset these inducements Mr. McMichael instructs his subordinates to make known the fact that there is an agreement between the Postal and Western Union companies to maintain equal rates between all points where both have offices. This circular has caused considerable mystification. The Postal Telegraph company's representatives say: "The original Postal Telegraph company has an agreement with the Western Union not to maintain equal rates, but allowing the Postal company to charge a 5 cents' lower rate, computing on the basis of a ten-word message. The Western Union gets even, however, by meeting our rate with its side show the Mutual Union. The [illegible] Postal Telegraph company, which is building [illegible] connects with our lines in Milwaukee, and is a separate concern. I don't know whether their agents are making any such offers as McMichael claims, or not." Vice-President Payne of the new company denies that any arrangements have been made with the Western Union company.

Miscellaneous Notes.

Murderers sentenced to death in New York after [illegible] will go ohm to dynamo.—[illegible]

The Rhodes & Keese Electric company of Los Angeles, Cal., has been incorporated, with a capital stock of $[illegible]

The Hyde Park Standard Time District Telegraph company of Hyde Park, Ill., has been [illegible] electrical business, capital stock $[illegible] H. G. Smith and K. [illegible]

Another [illegible] inventor of the [illegible] has appeared. M. I. Pease of Des Moines [illegible] he began experimenting with [illegible] electricity, and in 1857 he says [illegible] with success. That year [illegible] Office at Washington [illegible] under the name of [illegible] Later [illegible] perfected [illegible] desired to have his claims passed [illegible] Washington.

During a recent [illegible] [illegible] in distinctly audible tones, [illegible] speeches in [illegible] [illegible] asylum, in which he was [illegible] up to the time of his death. [illegible]

[illegible] lines from "Ar[illegible] [illegible] ned, and then [illegible] ugh, and sent [illegible]

[illegible] recently been made on [illegible] brake [illegible] attention of railroad [illegible] proved satisfactory it is quite probable an extended trial will be given the in[illegible] [illegible] Boston.

[illegible] throughout the country January 10th. Reports from storm centers indicate great damage to telegraph, telephone and electric light wires. In many places the wires were down for a short time, but the excellent organization of the telegraph companies prevented any serious or protracted delay in the transmission of [illegible] for a comparatively short time.

"The blizzards of the west are electrical storms," says [illegible] as regards electricity of the atmosphere change the character and shape of snow crystals. In a true blizzard the flakes of snow are sharp-cornered, like particles of ice, and the wind packs them in almost impenetrable drifts. People used to suppose that [illegible] snow banks solid in some cases and porous in others. The truth seems to be that these results depend rather upon electrical conditions of the atmosphere. It is only lately that scientists have seriously studied this subject. Less strange things have happened than that men should try to change the electrical conditions that produce storms." It might be asked parenthetically if the blizzards of the east are not electrical storms.

Personal Paragraphs.

C. D. Shain of the United States Electric Lighting company, Chicago, is east on a business trip.

C. E. Stump, treasurer and business manager of the [illegible], New York, was in Chicago last week.

C. B. Fitch of the Fort Wayne Jenney Electric Light company of Fort Wayne, Ind., was in Chicago last week.

[illegible] Barton, general manager of the Thomson-Houston Electric company, Chicago, has returned from his eastern trip.

Anthony Reckenzaun, the well-known London electrician, expects to be in Chicago at the time of the electric light convention.

E. M. Barton, president of the Western Electric company, Chicago, and Charles E. Scribner of the same company, [illegible] from Havre for New York January 5th. During their short stay abroad they passed most of their time in Berlin. They reached New York last Monday.

Charles Carr of New York city was in Chicago last week. He will hereafter be connected with the Pacific Storage company of San Francisco, the coast representatives of the Electrical Accumulator company of New York, with which he was formerly connected.

Business Mention.

James & Rogers, consulting engineers and designers, 5 West Fourth street, Cincinnati, Ohio, are making a specialty of preparing designs, working drawings and blue prints for the general machine trade.

The Clark Electric company of 159 Chambers street, New York, has just published a tasty pamphlet which contains a full description of the Clark system of arc lighting. The system has proved highly efficient.

The Pond Engineering company, St. Louis and Kansas [illegible] "We are prepared to furnish any style of pump valve adapted to the standard makes of pumps, and to withstand the action of any liquid."

The Bentley-Knight Electric Railway company has opened an office at 603 Pullman building, Chicago. This company is represented by Jabez Gorham. An apparatus illustrating the workings of the Bentley-Knight system will be ex[illegible]

[illegible] Wabash avenue, [illegible] branches to their business. They have secured the western agency for the I. W. Colburn & Co. dynamo machines for arc and incan[illegible]

[illegible]

[illegible] company of [illegible]

Electrical Patents.

[illegible], 1889.

395,692. Electric Train Brake Apparatus. Augustin L. Ambler, Washington, D. C.

395,703. Trolley for Electric Railways. Wilton J. Jenkins, Richmond, Va.

395,708. Dry Voltaic Battery. Isidor Kitsee, Cincinnati, O.

The compound consists of chloride of ammonia, bisulphate of mercury and glycerine.

395,755. Holder for Electric Arc Lamps. Jacob Pawlowski, Cincinnati, O.

395,761. Conduit for Electric Railways. Samuel Trott, Halifax, Nova Scotia, Canada.

The third claim is: "A metallic conduit for electric railways, upright pins screwed into the base thereof, jam nuts for securing the pins, and bell-insulators screwed to the outer end of the pins."

395,769. Voltaic Battery. Theophilus Coad, Forest Gate, County of Essex, England.

395,773. Cathode for an Electro-Depositing Apparatus. Elisha Emerson, Providence, R. I.

395,781. Art of Compiling Statistics. Herman Hollerith, New York, N. Y.

Claim 1 reads: "The improvement in the art of compiling statistics, which consists in first preparing a series of separate record cards, each card representing an individual or subject; second, applying to each card at predetermined intervals circuit-controlling index-points arranged, according to a fixed plan of distribution, to represent each item or characteristic of the individual or subject, and third, applying said separate record cards successively to circuit-controlling devices acted upon by the index points to designate each statistical item represented by one or more said index points."

395,782. Art of Compiling Statistics. Herman Hollerith, New York, N. Y.

395,783. Apparatus for Compiling Statistics. Herman Hollerith, New York, N. Y.

The third claim reads as follows: "The combination, with a series of electro-magnets and the series of mechanical counters actuated thereby, said electro-magnets being arranged in circuits controlled by relays of a perforated sheet of electrically non-conducting material, said perforations representing statistical items controlling the circuit through the electro-magnets of the relays."

395,814. Support for Aerial Electric Conductors. Henry H. Cutler, Newton, Mass.

395,835. Mode of Preparing Solution Compounds for Galvanic Batteries. William P. Kookogey, Brooklyn, N. Y.

395,836. Apparatus for Charging and Discharging Secondary Batteries. William P. Kookogey, Brooklyn, N. Y.

The storage battery is alternately connected in parallel in the charging circuit and in tension series with the working circuit, by a commutating mechanism operating a series of circuit closers and breakers.

395,837. Method of Preparing Solution Compounds for Galvanic Batteries. William P. Kookogey, Brooklyn, N. Y.

The invention in general consists in dissolving the bichromate of soda in a small quantity of boiling water before mixing it with the other ingredients of the compound.

395,851. Stop-Motion for Warping Machines. Lewis H. A. Schwartz, Philadelphia, Pa.

395,862. Apparatus for Indicating and Recording Changes at a Distant Point. George E. Winslow, Waltham, Mass.

The apparatus comprises a transmitter that is operated by changes in the water level; this transmitter thereby producing changes in an electric circuit which cause an electric current to operate a receiving instrument at the place where the changes are to be indicated.

395,878. Process of Electric Welding. Charles L. Coffin, Detroit, Mich.

The process consists in subjecting the articles to the action of a voltaic arc of which one pole is metal conductor, fusing said conductor, depositing the molten metal on the joint of the two articles, and reinforcing said joint by such molten metal.

[illegible]32. Medical Battery. Henry E. Waite, New York, N. Y.

[illegible] Regulator for Incandescent Electric Lighting Systems. Moses J. Wightman, Hartford, Conn.

The invention consists in a regulator which auto[illegible] compensating resistances [illegible] of the lamp in the [illegible] was removed therefrom. It consists further in [illegible] regulator with a cut-[illegible] safety devices.

[illegible] John N. Caper, Brooklyn, N. Y.

[illegible] covered with a thick [illegible] connector at [illegible] carbon would [illegible] stated would [illegible]

[illegible] Mark W. Dewey, [illegible]

[illegible] Electric [illegible] Apparatus. Mark W. Dewey, [illegible]

The first claim reads: "In an electric alarm system, the combination, with the transmitting instrument, of an auxiliary circuit and an electromotor in said circuit, and connected with the transmitting instrument to operate the same, and a stop to limit the movement of said motor."

395,961. Electrical Store-Service Apparatus. Richard N. Dyer, East Orange, N. J.

The object of the invention is to produce a simple and efficient apparatus for carrying cash or parcels in stores, the traveling carriers of which will be operated by electrical energy, and which will have outgoing and returning ways.

The fourth and ninth claims are given: "In electrical store service apparatus, the combination, with carriers having depending bails, of outgoing and returning ways, each of which is broken and deflected laterally at stations, and bridging switching plates at such breaks for lifting carriers to or from succeeding stations over such breaks."

In electrical store-service apparatus, the combination, with outgoing and returning ways, having each two tracks connected with the source of electrical energy, of a section of track disconnected from the circuit and joining the ways together at the cashier's end.

395,962. Method of Manufacturing Electric Lamps. Thomas A. Edison, Menlo Park, N. J. Filed Sept. 22, 1882.

The invention relates to exhausting the globes and consists of placing within the globe a compound of chlorine or equivalent thereof, and then withdrawing the air from the globe and heating the filament of the lamp to incandescence by an electric current during a portion of the time that the air is being exhausted.

395,963. Incandescent Lamp Filament. Thomas A. Edison, Menlo Park, N. J.

The invention consists in volatilizing a substance having a high electrical resistance by electrically heating such substance in a vacuum, and causing such substance to be deposited in the form of filaments, or as a sheet from which filaments are formed.

395,974. Electrical Measuring Apparatus. Hammond V. Hayes, Cambridge, and Anthony C. White, Boston, Mass.

Claim 2 is as follows: "In an electrical measurement apparatus, the combination of the testing circuit, the galvanometer in a bridge dividing said circuit into two parts, a standard battery and fixed resistance on one side of said bridge, an adjustable resistance and terminals for introducing a generator to be tested on the other side of said bridge, so that the current of said generator will oppose that of the standard battery in the galvanometer, and a compound circuit controlling key normally maintaining both divisions of the circuit as well as the bridge open, but adapted when depressed to close both divisions, and also said bridge."

396,009. Forming, Brazing and Welding of Metals by Electricity. Elihu Thomson, Lynn, Mass.

Claims 2 and 6 read: "In an electric metal-working apparatus, die or forming surfaces faced with a non-conductor of heat of a refractory nature. The combination, with suitable holders for rotating a metal piece, and suitable connections for passing a heavy electric current through the same, of one or more lateral die-rolls."

396,010. Method of Electric Forging. Elihu Thomson, Lynn, Mass.

The first claim reads as follows: "The herein described art of upsetting metals into any desired shape, which consists in subjecting the blank to be worked to the heating action of a heavy electric current sufficient in volume to soften the same, and then subjecting the blank to an endwise pressure."

396,011. Method of Electric Welding. Elihu Thomson, Lynn, Mass.

The third claim is given: "The herein described method of finishing an electrically welded joint, consisting in simultaneously applying a heating electric current, and a force tending to separate the joint while subjecting the joint to the hammering or other operation."

396,012. Apparatus for Electric Welding and Working Metals. Elihu Thomson, Lynn, Mass.

396,013. Electric Pipe-Joining and Pipe-Work. Elihu Thomson, Lynn, Mass.

The fourth claim follows: "The herein-described improvement in electrically welding lead, tin or other soft pipes, tubes or tubular pieces, consisting in forming the abutting end of the tube with a narrowed edge preliminarily to the welding operation."

396,014. Electric Metal Working. Elihu Thomson, Lynn, Mass.

The first claim is appended: "The hereinbefore described method of reducing or separating metal rods, bars or pieces, consisting in heating the same by an electric current of large volume, and then applying a suitable force to separate the metal, or to extend the same at the heated section."

396,015. Method of Electric Riveting. Elihu Thomson, Lynn, Mass.

The first and last claims read: "1. The herein described improved method of riveting, consisting in heating the rivet or rivet-blank electrically while in place and then heading either or both ends of the same.

"7. The herein described method of electric riveting, consisting in pressing the plates together, heating the rivet inserted through the plates by a heavy electric current flowing through the same, and applying end pressure to the rivet to head or set the same."

396,039. Coupling for Gas and Electric Light Fixtures. Reinhold Herman, Crafton, Pa.

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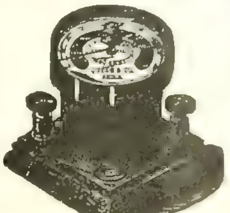

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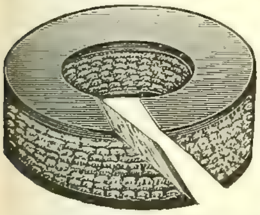

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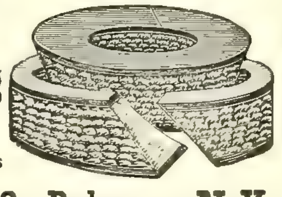

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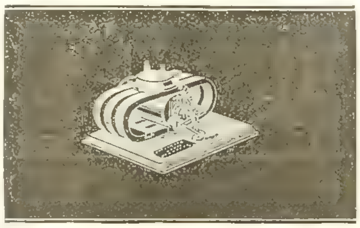

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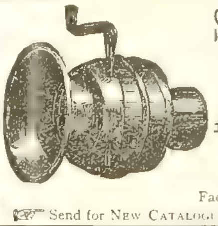

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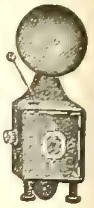

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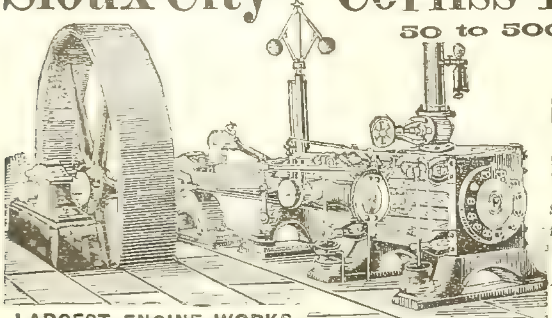

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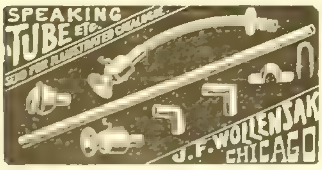

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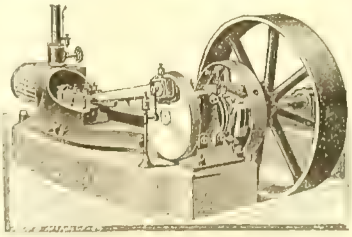

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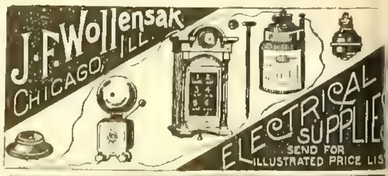

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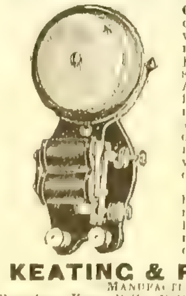

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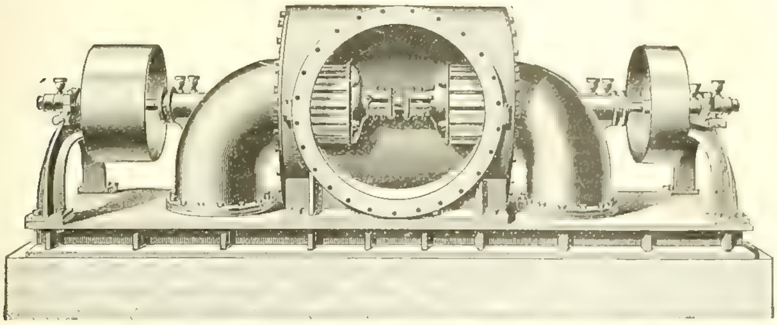

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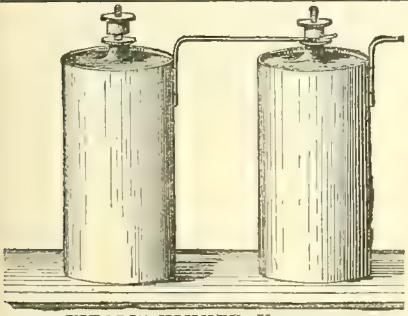

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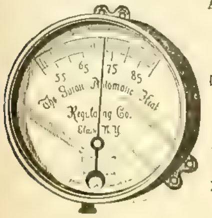

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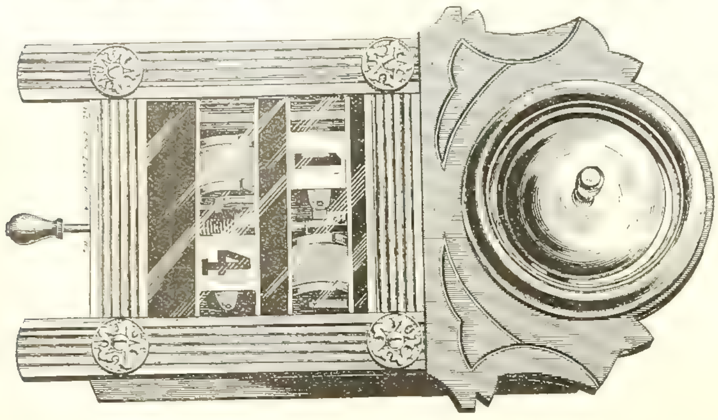

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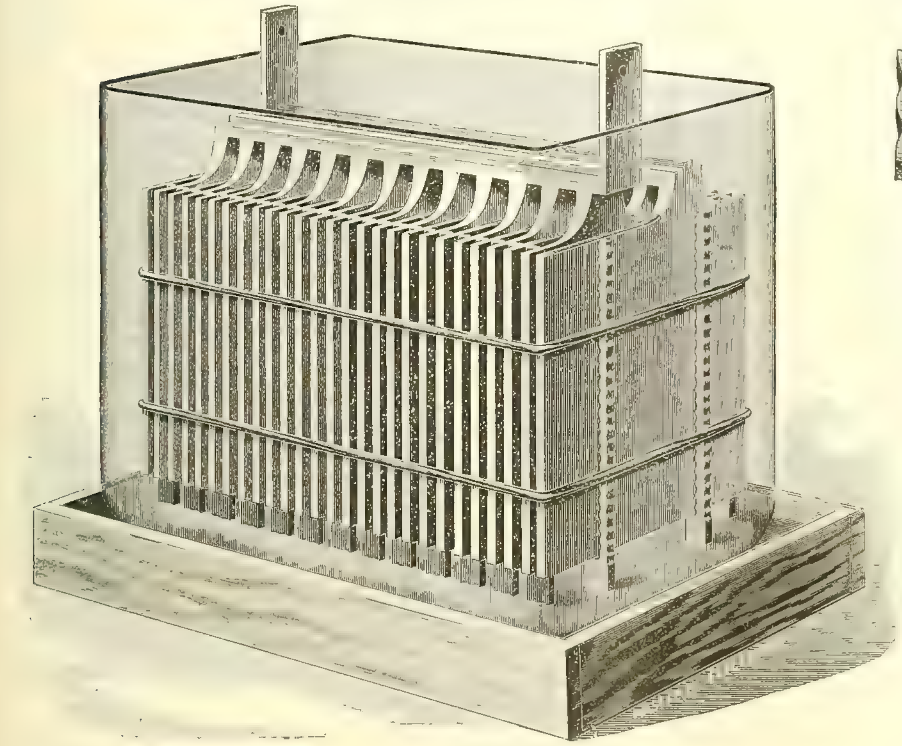

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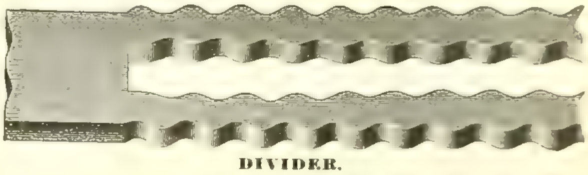

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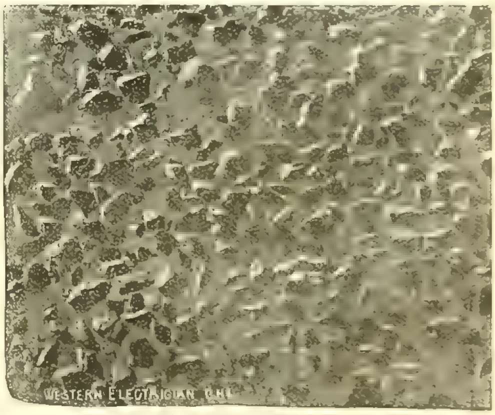

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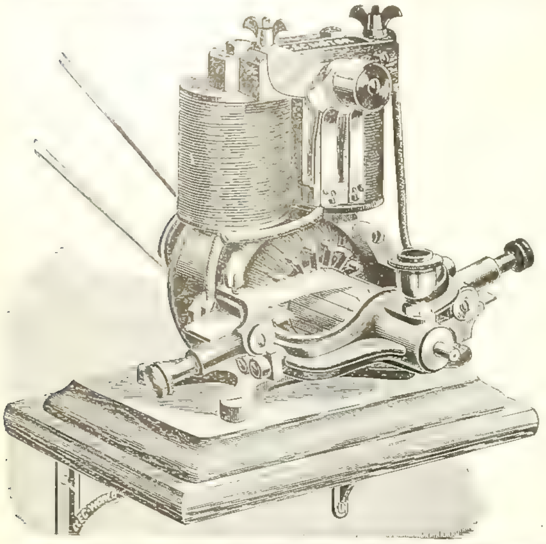

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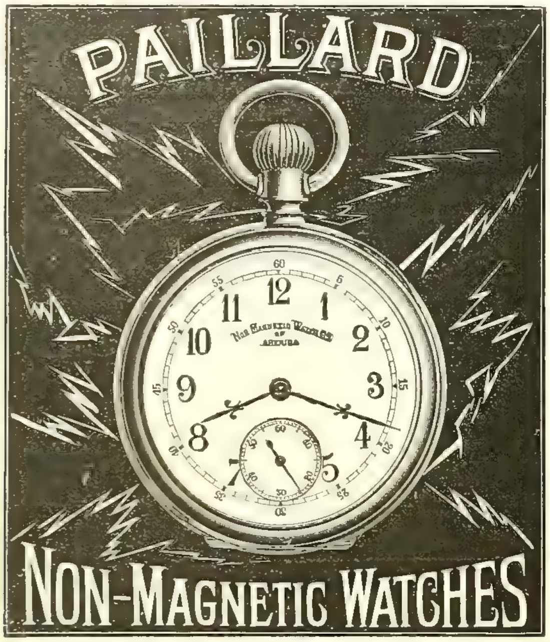

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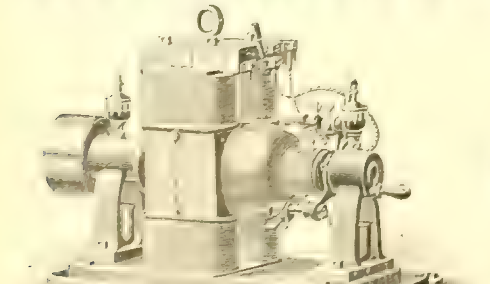

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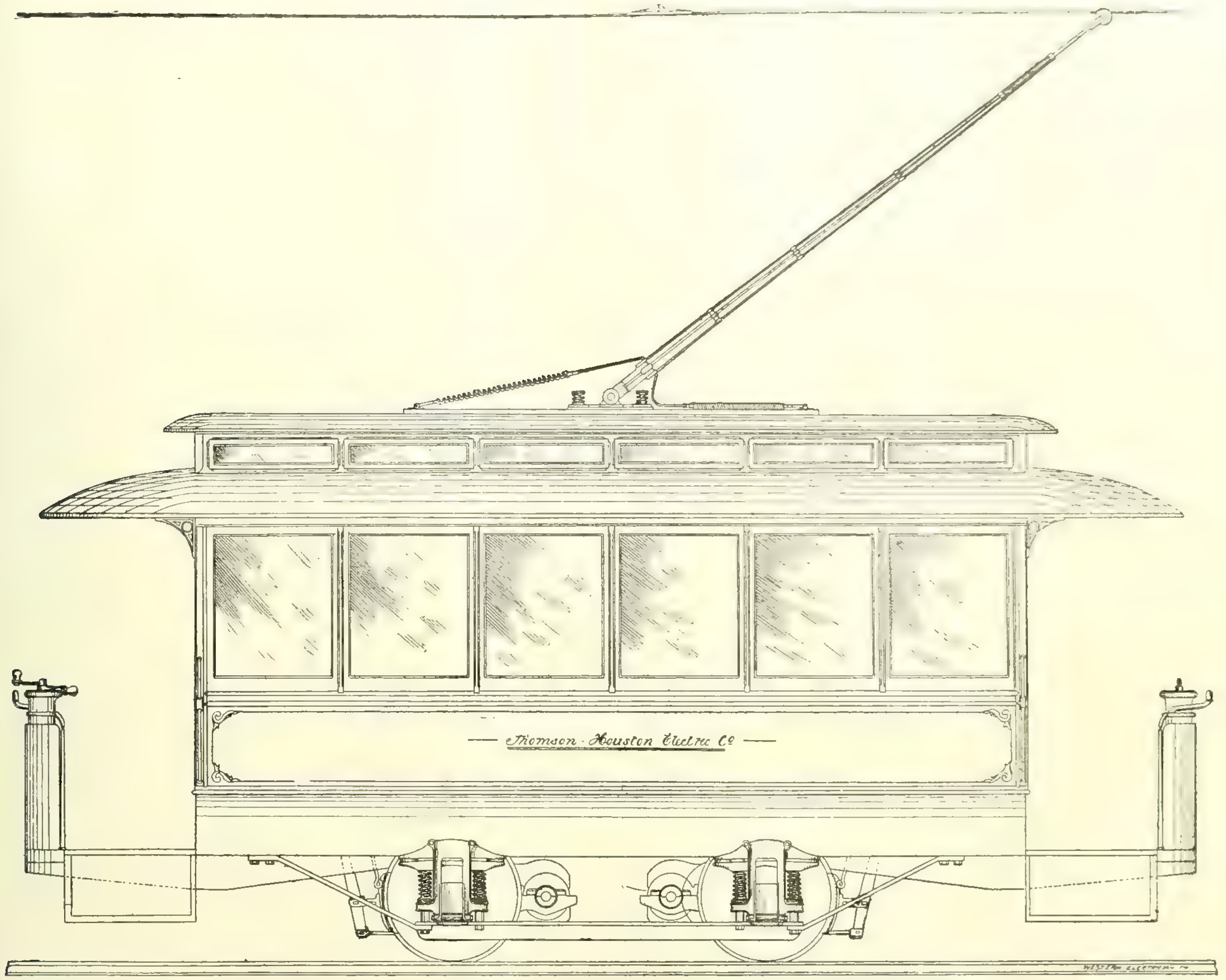

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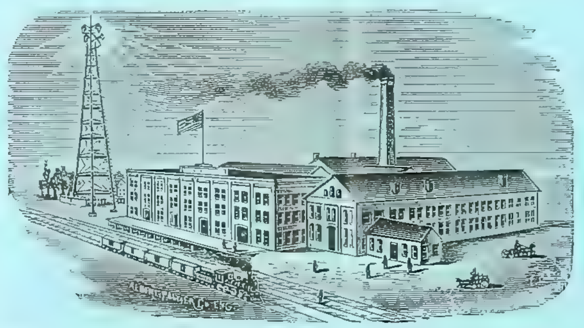

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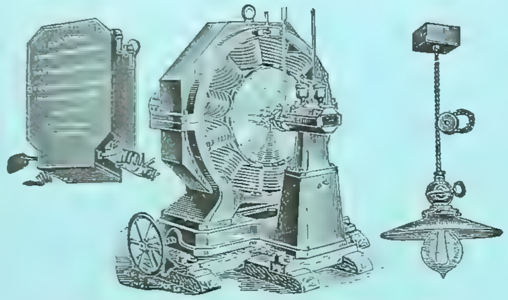

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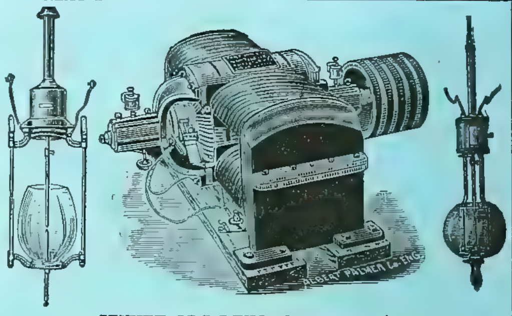

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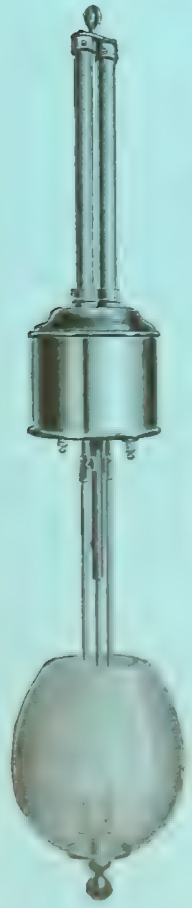

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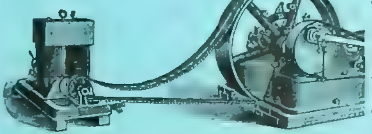

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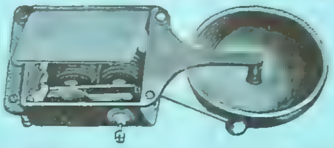
Superior to  All Others.

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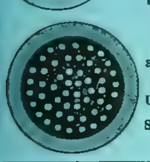

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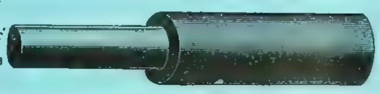

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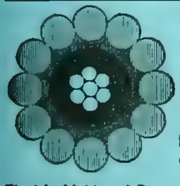

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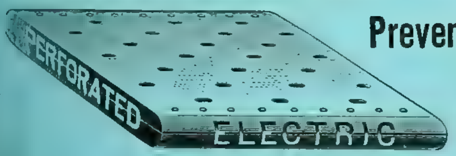

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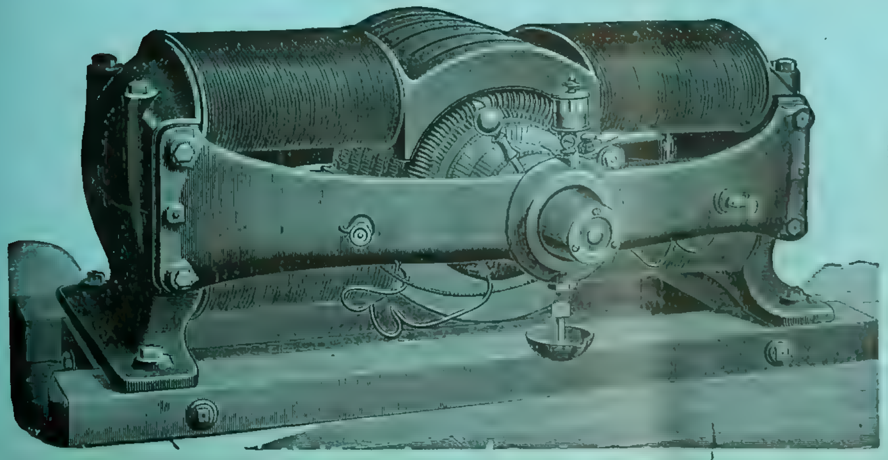

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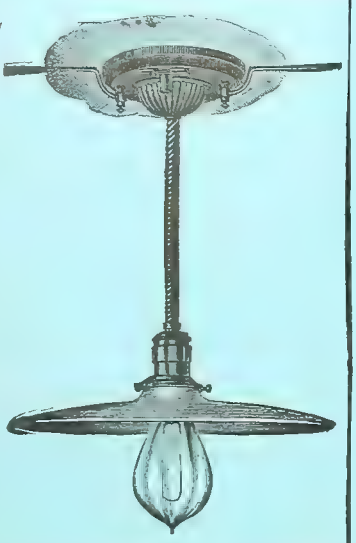

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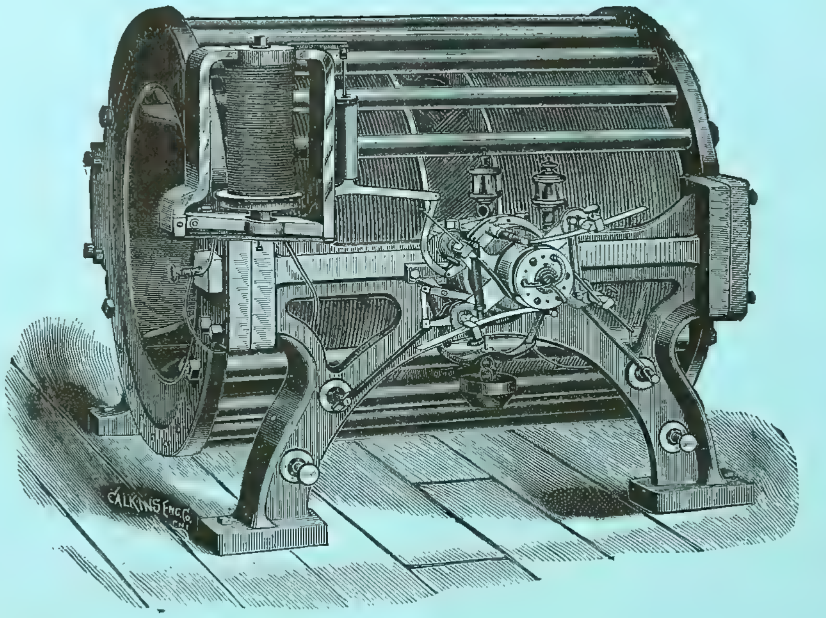

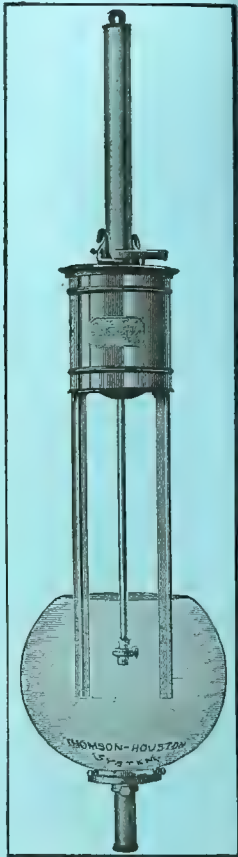

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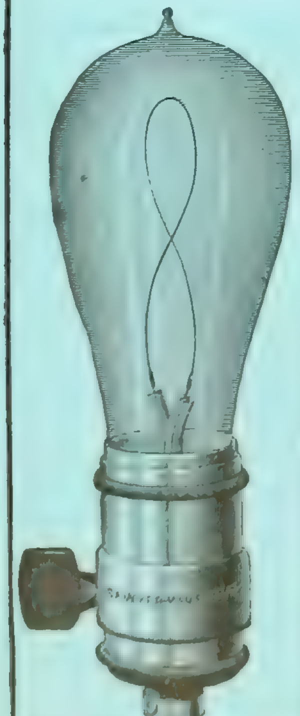

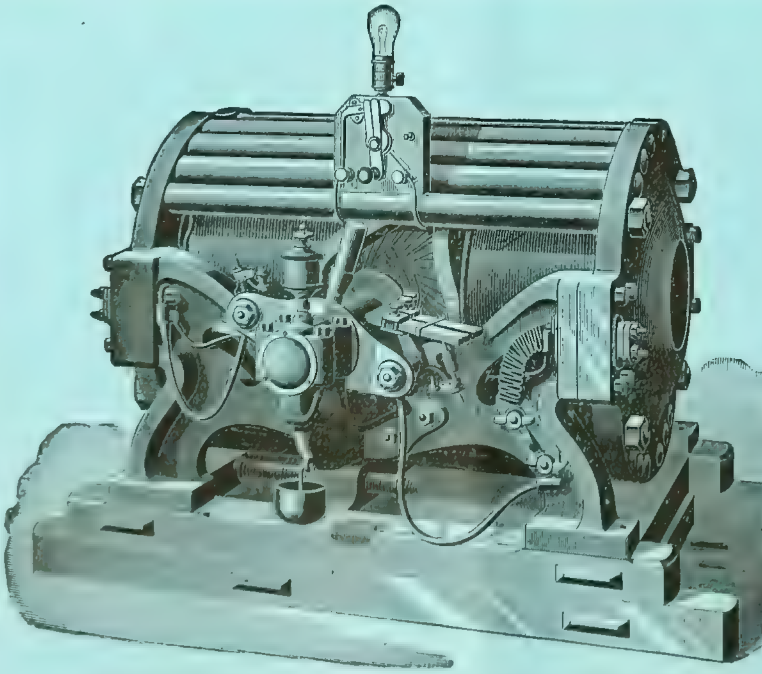

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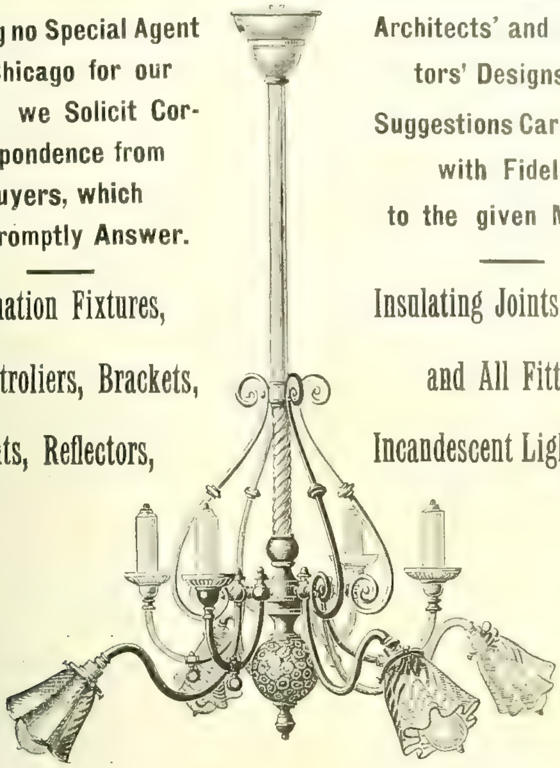

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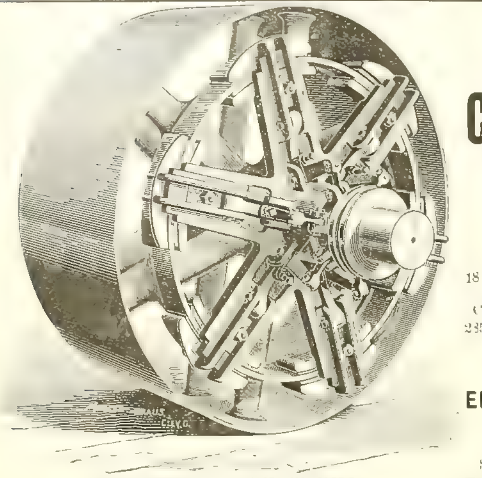

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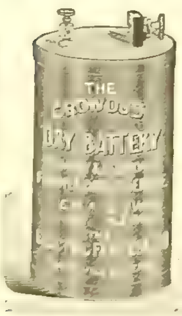

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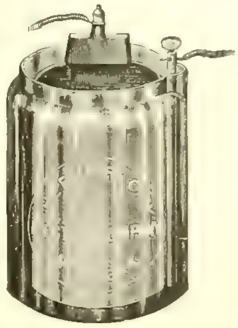

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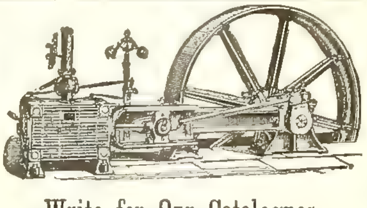

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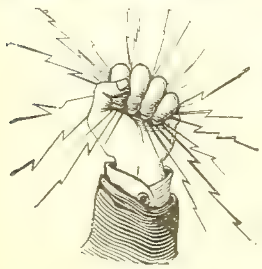

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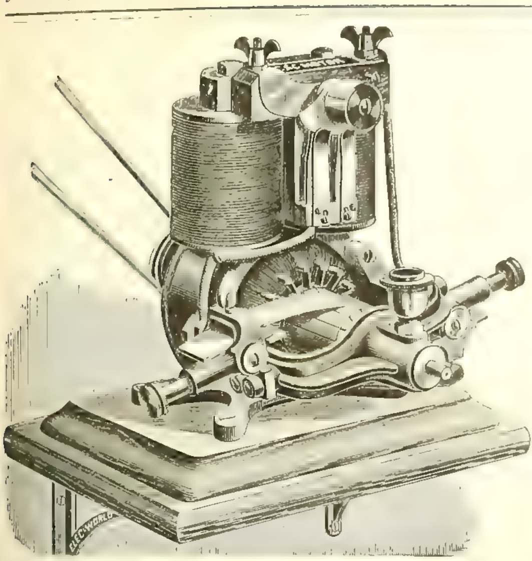

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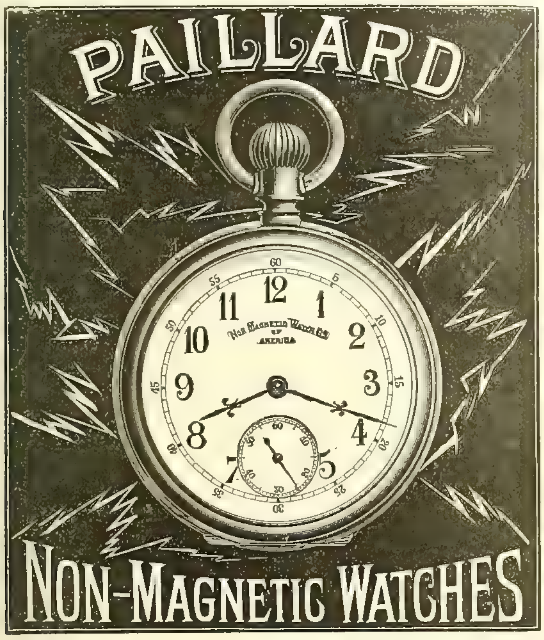

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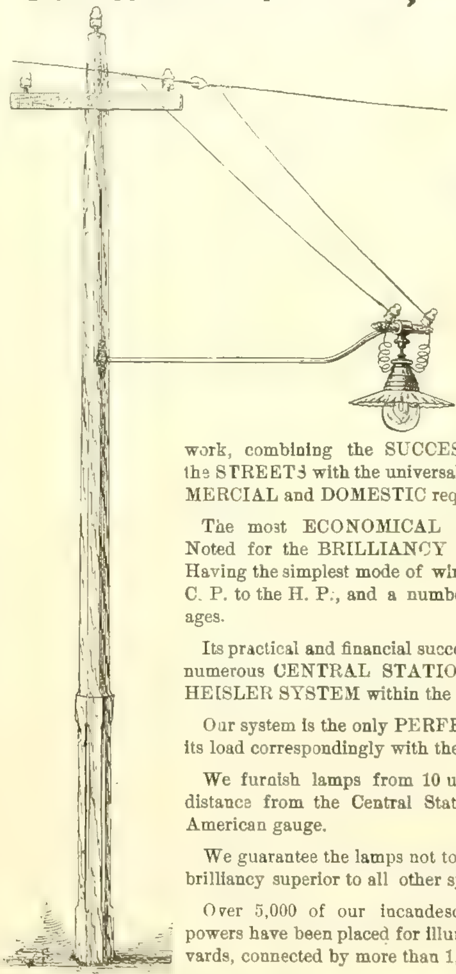

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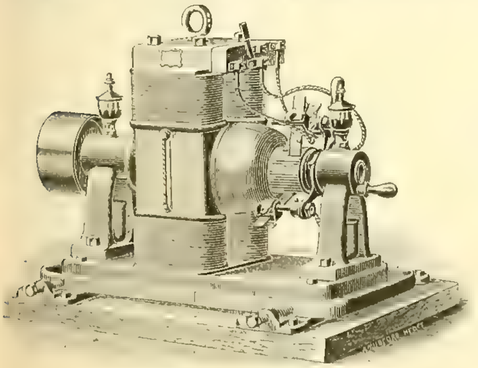

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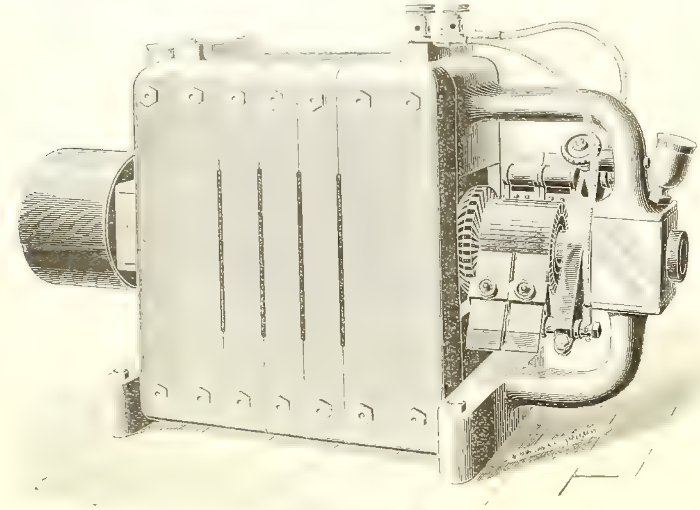
ELECTRIC MOTORS.

(United States Patents, Feb. 22, 1887; Feb. 14, 1888.)



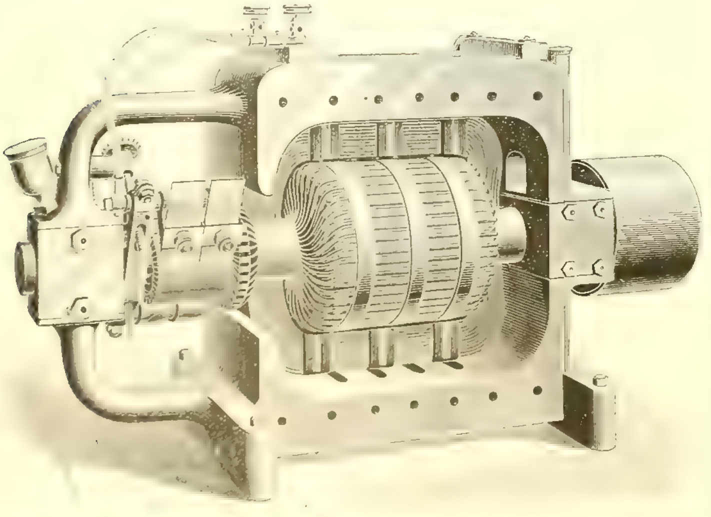
Machine Complete

Combine the simplest Construction and Highest Efficiency yet obtained in Dynamo-Electrical Apparatus.

PERFECT ELECTRICAL Balance in ARMATURE COILS.
NO RADIATION OF FIELD MAGNETISM.

There being no magnetism apparent at any exposed surface of the machine, all the lines of force are concentrated within the machine, and pass through the armature.

NO SPARKING AT THE COMMUTATOR.



Machine [illegible] showing the inside arrangement of armature and coils.

These machines in all sizes and of any required capacity, are for general sale on their merits **to the Trade,** to **Contracting Engineers,** to **Electric Light, Power, and Storage Battery Companies,** and to the public without restrictions or royalties as to territory or patents.

Low Prices. Compact Machines.

SEND FOR DESCRIPTIVE PAMPHLET.

J. H. BUNNELL & CO.,
SOLE AGENTS
106-108 LIBERTY STREET, N. Y.

MACRAEON
STORAGE BATTERIES
FOR ELECTRIC LIGHTING.

The MACRAEON STORAGE BATTERIES do not "buckle," "blister" or "sulphate"—are the simplest in construction—are made with **CLOSED METAL BOXES**—require less attention, and will last longer than any other battery in the market, being practically indestructible and of great efficiency.

These Storage Batteries can be Profitably Used for:

1. Incandescent Lighting on Arc Circuits everywhere using the same Dynamo and power while idle during the day, for charging the Batteries.
2. Incandescent Light Plants, whether **isolated** plants or **central stations,** can be doubled in capacity by using the Macraeon Storage Batteries.
3. **Surplus Power,** Steam or Water, even irregular, wherever it can be had, in Factories, Breweries or business buildings, can be utilized to great advantage and profit by storing electricity during the day for lighting the place or neighborhood at night.
4. Storage Batteries can also be used for **steadying** incandescent or arc lights when run direct from the dynamo.

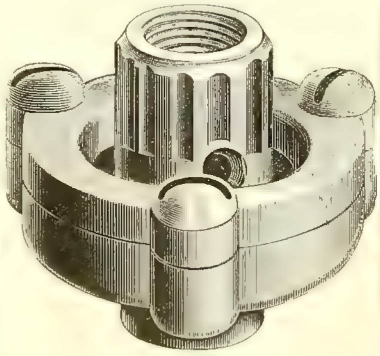
Incandescent Lighting from the Macraeon Storage Batteries is UNIFORM, STEADY and RELIABLE. No Flickering, less Breakage of Lamps, and, like gas, the light is always on hand day or night.

CORRESPONDENCE SOLICITED. ESTIMATES FURNISHED.

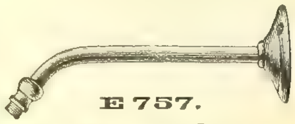
Complete Installations made, including Dynamos and Motors. Special terms to Electric Companies, Contractors and Supply Agents. Address

GEO. WM. BALLOU, President, or LEONARD PAGET, Chief Electrician,

Macraeon Storage Battery Co.,
7 Wall St., NEW YORK.
FACTORY, 110-114 Dickinson St., - - TRENTON, N. J.

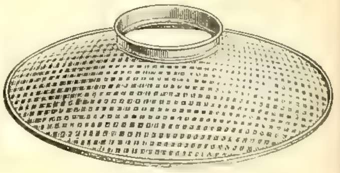


E 463.
INSULATING JOINT.
(THE STANDARD.)



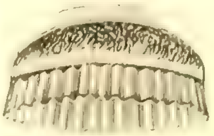
E 757.

E 754



E 800.

E. P. GLEASON MFG. CO.,
181-189 MERCER STREET,
NEW YORK.
CHICAGO OFFICE, 233 LAKE STREET.
MANUFACTURERS OF—
ELECTRIC APPLIANCES
IN BRASS, IRON, TIN AND GLASS,
Embracing Fittings, Brackets, Fixtures, Shades, Globes, Insulating Joints, Cut-outs, Holders, all Systems, and Supplies for Arc and Incandescent Lighting.
SEND FOR CATALOGUE "E" 1889.



E 48
CRYSTAL.

ETCHED.
E 36.

E 39.
IN EIGHT COLORS.

THE

Westinghouse Electric Co.,

PITTSBURGH, PA.

[**Manufacturers under Patents and Applications for Patents controlling the sale and use of Alternating Current Electric Lighting Apparatus and Distributing Systems.**]

The success of the Alternating Current System of Electric Lighting is demonstrated beyond question.

Note the sale of 132 Central Station Plants by this Company, aggregating a total generating capacity of 240,000 16-candle-power lamps, within the brief period of twenty-four months, together with the fact that out of these 132 Central Stations, 38 have increased their plants since starting.

IMPROVED LAMPS.

By reason of an improvement in the manufacture of Lamps which has been secured for the exclusive benefit of the users of apparatus furnished by the Westinghouse Electric Company, this Company will guarantee from its Apparatus and Lamps 50 per cent. more light from a given expenditure of power (fuel) than can be obtained with any direct current system.

ALTERNATING CURRENT METERS.

This Company's Meter measures the whole current by a positive mechanical movement.

It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

ALTERNATING CURRENT MOTORS.

Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

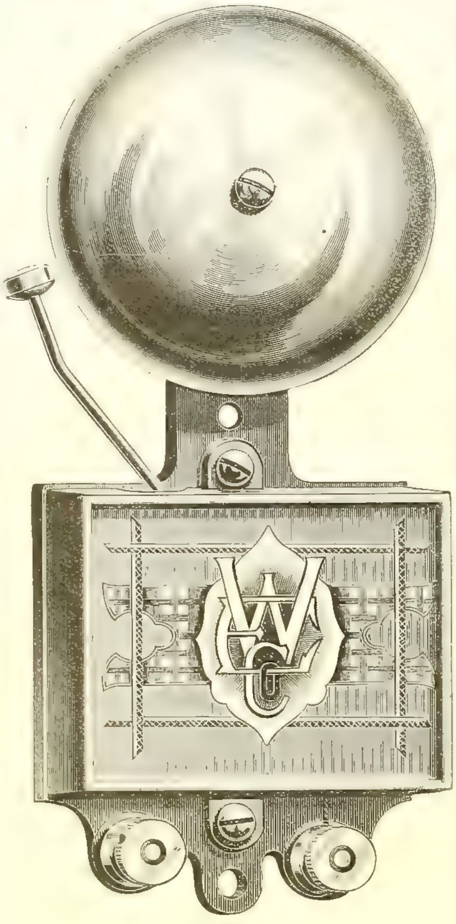
Small Motors for use on existing Alternating Circuits of this Company.

BELLS, BATTERIES AND PUSHES

Quad Carbon Battery.

Prices upon Application.

New Style Iron Box Bell, No. 1006.



(Cut Full Size.)

Disque Battery.

Prices upon Application.

Bronze Push No. 1004.

Price, 75 Cents.

Sample Sent by Mail on Receipt of 65c.

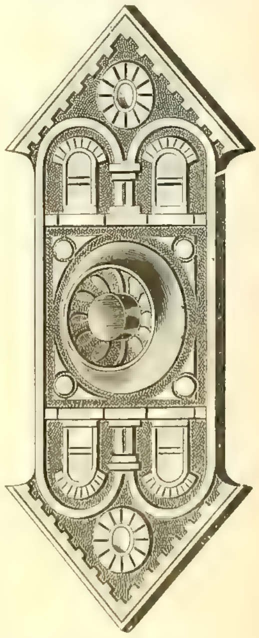
Agents for the Gassner Dry Battery.

Oval.

Cylindrical.

Medical.

Bronze Push No. 1003.



Price, 75 Cents.

PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO, NEW YORK, LONDON, ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. IV. CHICAGO, JANUARY 26, 1889. No. 4

The Hall Dynamo.

The accompanying cut illustrates a single horseshoe dynamo with Gramme armature, made by S. Charlesworth & Co., Oldham. The machine is intended for an output of 280 amperes at 100 volts pressure when driven at a speed of 350 revolutions per minute, and its weight is 2 tons, 4 cwt., says *Industries*. It is arranged for rope driving from the main engine of a mill, and the rope sheave is provided with a friction clutch, so that the machine may be stopped while the ropes are kept running. The armature is 15 inches in diameter by 11 inches long, and the core is built up of No. 24 B. W. G. charcoal iron plates, insulated from each other by paper .001 inch thick. The plates are mounted upon a brass frame, the end casting of which is pressed home by a nut on the shaft. The winding of the armature consists of 160 turns of 238 mils wire, the weight of copper being 82 pounds and the resistance .0214 ohm. The commutator has 80 sections. The magnet cores are of wrought iron, and of cylindrical shape, the diameter being 11 inches. The machine is compound wound with the shunt next to the core, and the shunt winding consists of eighteen layers of 69 mils wire having a resistance of 36 ohms. The series winding consists of 56 turns of 37 1-2 B. W. G. cable, the resistance being .0056 ohm. The weight of copper in the shunt is given by the makers as 240 pounds, and that in the main coils as 322 pounds, making a total weight of copper on the machine of 644 pounds. The machine is provided with the usual sliding rails and tightening screws to take up the slack in the ropes. We are informed by the makers that no part of the machine rises above 190° F. during a twelve hours' run with full load, and that the maximum variation in the pressure between light and full load does not exceed 2 per cent.

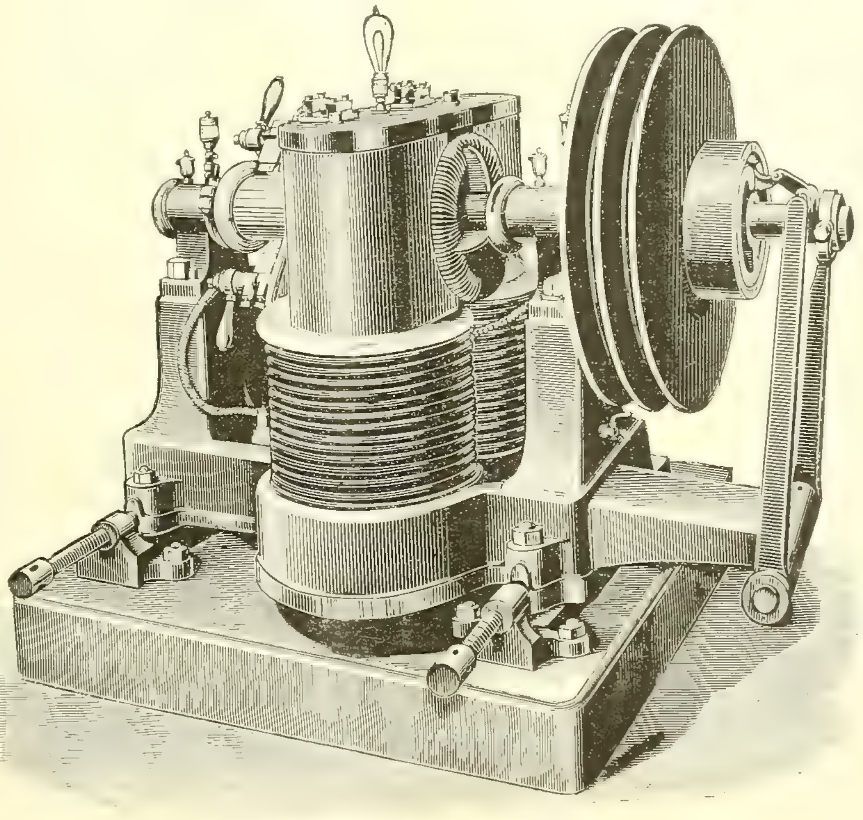


FIG. 1.—THE HALL DYNAMO.

Electric Train Lighting on the Chicago, Milwaukee & St. Paul Railroad.

Two of the trains on the Chicago, Milwaukee and St. Paul railroad are now lighted by electricity. The first train equipped with the electric light apparatus left Chicago January 15th for St. Paul. The train returned on the following day, and, as it was stated, the lights scarcely flickered once during the round trip. The installations were made by Leonard & Izard, Chicago. The plant consists of an Eickemeyer dynamo of 80 volts and 80 amperes, a Brotherhood engine and a battery of accumulators. This plant is located in the front part of the baggage car. Steam is supplied from the engine.

About 100 lights are furnished with current by the dynamo directly. The storage batteries serve as a reserve. At midnight, however, the employe in charge of the dynamo leaves his post and thereafter the storage batteries supply the lamps which happen to be burning. The equipment has several novel features, the nature of which the installing firm is not yet ready to disclose. It is stated, however, that the voltage is kept constant. On the first trip the voltmeter showed that the greatest change was less than half a volt.

Storage batteries manufactured by four different companies are to be used at first and thoroughly tested. That form will be adopted finally which gives the best satisfaction. Special dynamos and special engines have been ordered for the equipment of the trains. The trial trips have given the greatest satisfaction, not only to the officers of the road, but to the passengers who were fortunate enough to travel on the electrically lighted coaches.

Electrically Lighted Cable Car.

A cable car on the North Side railway, Chicago, has been wired for incandescent lights. It is proposed to light this car when it enters the La Salle street tunnel. The tunnel itself is brilliantly illuminated by arc lights, but the passengers are unable to continue the perusal of their papers. The experiment is to be made with a single car, and probably other cars will be equipped. Current will be taken from the power house plant. The installation is to be made by Leonard & Izard.

It is interesting to note in this connection that a plan has been proposed to light an entire line of street cars in Chicago by storage batteries. It is said that two-volt lamps will be employed if the plan is adopted.

Chicago Telephone Rates.

A bill was [illegible] ture, [illegible] of telephone rates [illegible] bill provides that when one instrument [illegible] the rental shall not exceed $3 per month, and when more [illegible] son the charge shall not exceed $2 per month for each. Where cities, towns and villages are connected by telephone the rate for the service shall not exceed 15 cents for the first five minutes' conversation, and for each additional five minutes no sum exceeding 5 cents shal[illegible] charged. Any owner, operator, or agent, who shall charge or collect in excess of the rates so fixed shall be guilty of extortion, and shall be fined not less than $50 nor more than $100 for the first offence, for the second offence not less than $100 nor more than $200, and for each subsequent offence shall be liable for a fine of $500. In all cases the right of trial by jury is allowed.

Superintendent Wilson of the Chicago Telephone company said it would be impossible for the company to do business under such rates. Subscribers demand first-class service, and are satisfied with nothing else. The company could not give this service under the proposed rates. In Indiana it was found impossible to continue the business when the telephone company was hampered by legislative restrictions. There a rate of $3 and $2.50 was established by law, and the company was forced to discontinue business. To-day many towns [illegible] Indiana are without telephones, and the people are regretting the ill-advised action of their law-makers. In a few of the largest cities [illegible] that state a toll system has been adopted, each subscriber acting as agent for the telephone company, no rental being charged. Under this arrangement the receipts of the company [illegible] practically the same as under the old system [illegible] fixed rentals, but the interference [illegible] lature has had a demoralizing [illegible] ness, and it is believed that the law [illegible] pealed during the present session.

National Electric Light Convention.

Letters which B. E. Sunny, [illegible] executive committee of the N[illegible] Light association, is [illegible] that the attendance at the [illegible] in Chicago will be un[illegible] week C. B. Holmes of the C[illegible] company, offered to lay in the Exposition building tracks for the [illegible] cars. Mr. Holmes is [illegible] most progressive str[illegible] country [illegible] system [illegible] reached the development [illegible] attained, [illegible]

to lay an [illegible] successful operation. It is proposed [illegible] feet of track in the Exposition building. Motor cars will be run in the Exposition building during part of each day to illustrate the methods of operating the several systems. Several companies have already signified their intention to make temporary installations.

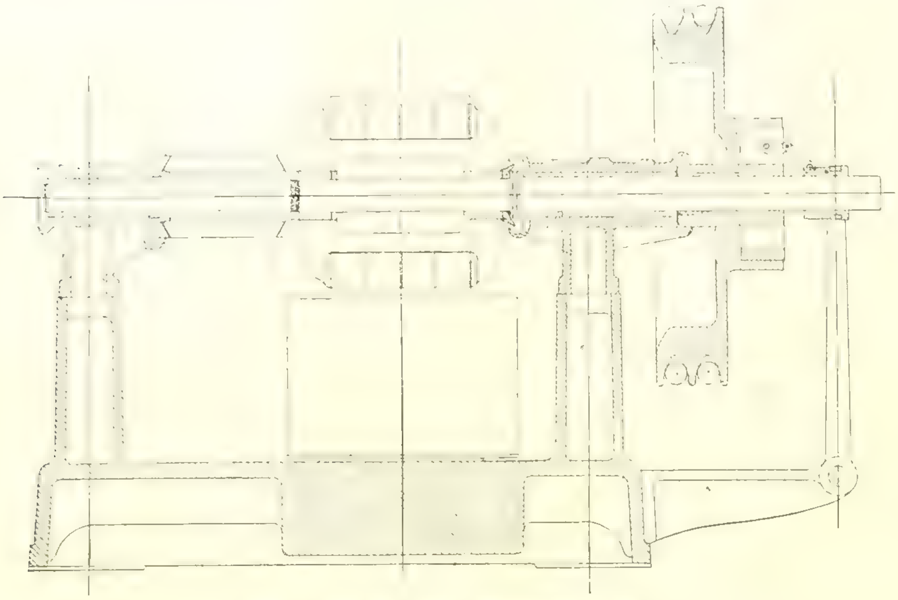


FIG. 2. THE HALL DYNAMO—SECTIONAL VIEW.

The executive committee has made arrangements for reduced rates at several hotels as follows: Leland hotel on Michigan avenue, one block from the Exposition building, $3 per day; Hotel Brunswick on Michigan avenue, directly opposite the Exposition building, $2 per day; Palmer house, State street, two blocks from the Exposition building, 50 cents less than the regular rates; Richelieu, Michigan avenue, one block from the Exposition building, parlor and bedroom without board, $10 to $18 per day.

The following companies have made arrangements to have exhibits at the convention:

New York Insulated Wire company, N. Y.; Knapp Electrical Works, Chicago; C. & C. Electric Motor company, New York; Non-Magnetic Watch company, New York; Woodward Electrical company, Detroit; Thomson-Houston Electric company, Chicago; Standard Underground Cable company, Pittsburgh; Eddy Electric Manufacturing company, Windsor, Ct.; Kester Electric company, Terre Haute, Ind.; Chicago Raw Hide Manufacturing company, Chicago; Waters Sweeney Telegraph & Telephone Switch company, Terre Haute; Phœnix Glass company, New York; Detroit Motor company, Detroit; E. P. Gleason Manufacturing company, New York; A. F. Moore & Co., Philadelphia; Belding Electric Motor & Manufacturing company, Chicago; Electrical Supply company, Chicago; The Chalmers-Spence company, New York; Lake's Glazed Conduit company, Washington, D. C.; Callender Insulating & Waterproofing company, New York; Waltham Watch company, Waltham, Mass.; Chas. A. Schieren & Co., Chicago; W. E. Cleveland, Cleveland, Ohio; National Electric Manufacturing company, Eau Claire, Wis.; Stilwell & Bierce Manufacturing company, Dayton, O.; Okonite company, New York and Chicago; Central Electric company, Chicago; Sperry Electric company, Chicago; Brush Electric company, Cleveland; [illegible] Engine company, Beloit, Wis.

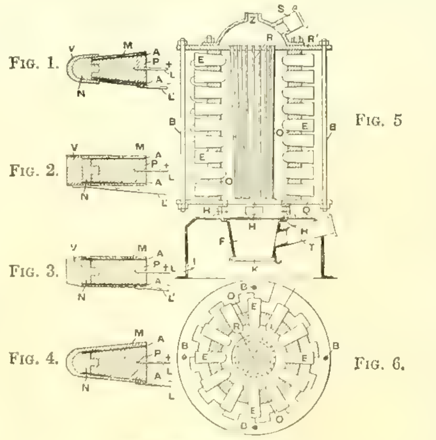
Demand for Electric Motors.

Commenting on the rapid advancement in electrical [illegible] What the people in general desire is electric motors, and they care very little [illegible] as long as their safe [illegible] motors, and there [illegible] of their [illegible]. For [illegible] patiently for [illegible]

[illegible]

Electric Furnace.

A new form of electric furnace is illustrated in the accompanying cuts. The invention is that of H. Mestern of Muenchen, Germany. An English paper, in describing the furnace, says: One of the drawbacks of the ordinary forms of electric furnaces is the fusibility of the alloys which are employed as the electrodes, and the consequent likelihood of an interruption of the current. Another arrangement which militates against the success of the battery is the exposure of the elements to the action of the fire and evolved gases. Four methods are illustrated in the accompanying Figs. 1–4, whose object is to overcome these difficulties. The positive elements *P* are made of antimony and zinc, or other suitable alloys, and they are connected in dovetail with the negative electrode *N*, which is composed of copper and nickel. An insulating



ELECTRIC FURNACE.

layer of asbestos *A* separates the protecting mantle *M* of iron or other resisting metal from the electro-positive alloy, and acts together with a strengthening cap *V* as a deflecting conductor for the negative electrode. *L* L^1 are deflection pieces made from an alloy of nickel and copper. In Fig. 1 the cap *V* is so shaped as to embrace the electro-negative metal, and to secure the protective mantle *M*. In Fig. 2 the cap forms a thermal conductor surrounded and held fast by the mantle *M*, while in Fig. 3 the conductor *V* is not surrounded by the mantle *M*. A modification in Fig. 4 shows the cap and the mantle made in one piece, *M*. In Figs. 5 and 6 the [illegible] battery is shown as made up of the [illegible] *E*. The body of the furnace is formed of [illegible] other material, and is so arranged that the [illegible] can be easily removed and replaced. A [illegible] *R* of iron bars is placed [illegible] the furnace and is adapted to be filled [illegible] through the [illegible] *S*. The ash box *T* [illegible] grate and fuel is supplied [illegible] through the [illegible] *F*. The air enters [illegible] *H* and *I* and the [illegible] escapes through the [illegible] *I*.

Thomson-Houston Electric Railways.

An excellent idea of the distinctive features of the Thomson-Houston Electric railway system is gained from the illustrations which are presented herewith. The roads, of which brief descriptions are given, are in successful operation, and are daily demonstrating the superiority of electric railways over other modes of street car propulsion.

The Omaha & Council Bluffs Railway & Bridge company started its cars in the latter part of November, and since that time they have been in daily operation, to the satisfaction of the owners and to the general public, which has been greatly accommodated by the opening of the rapid transit line between Omaha and Council Bluffs. The cars on this road are run faster than on any other road in the country, a speed of fifteen, and oftentimes twenty, miles an hour being attained. In the accompanying illustrations are shown several views of the road and the power station. The power plant consists of two 80 and one 40 horse power generators. This is the most extensive electric railway in the west, and it is complete in every detail of construction. The road comprises nine miles of track, on which are operated twenty-four 16-foot cars. Extensions have already been commenced, which will add several miles to the road. The road crosses the bridge which was opened with imposing ceremonies a few months ago. The approaches are lighted by twenty arc lights of 2,000 candle power each, current for which is supplied by a Thomson-Houston dynamo.

The Des Moines Broad Gauge railway, which has been equipped with the Thomson-Houston electric railway system, has been in successful operation since December 20th. The first trial trip made on this road was such as to convince the most skeptical of the practicability of the electric railway. The car had a load of eighty-seven passengers, and the rails were thickly covered with mud in many places, but these adverse conditions had no effect upon the operation of the car, which mounted the grades and rounded the curves with an ease and precision which clearly showed that the apparatus was capable of doing the heaviest required work. The total mileage is seven and a half miles, and eight cars will be operated. During the severe snowstorm in Des Moines, when about a foot of snow fell, the motor cars made their regular trips every fifteen minutes. The horse cars put on four horses, but could not then be run on time; the steam motor which runs to the north end of the city was ditched, so that the electric cars were the only ones in operation during the storm, a fact which speaks in no uncertain terms of the efficiency of electric systems. The receipts from four motor cars on this road are four times more than from five cars operated by horses.

The Third Ward Street Railway company, Syracuse, N. Y., which is operating the Thomson-Houston system, has been somewhat delayed by difficulties connected with the track construction, but it is now in operation. It has eight cars and four miles of track.

The Riverside & Suburban Railway company, Wichita, Kan., has operated electric cars successfully since starting, and the road has stood all the tests of bad weather and muddy and frozen streets. The cars have never lost a trip. The people of Wichita are enthusiastic over the road. The track is built of Johnston rails in the city limits, and the ordinary "T" rail is used outside. The power plant consists of two 50 horse power generators. Three cars are in operation, each equipped with Thomson-Houston motors, and lighted by electric lamps.

In two of the accompanying cuts are shown views of the Eckington & Soldiers' Home railway at Washington, D. C. This road has been in operation since the latter part of October, and has been run thus far without a hitch of any kind, which can be charged to the electrical apparatus. The patronage of the road has increased to such an extent that it has been necessary to double the car capacity. To each motor car is now attached an additional car, both of which are filled to their utmost capacity on every trip. The road is one of the finest which has been built in the United States.

Three of the improved Thomson-Houston trucks have been in use for some time on the

Scranton Suburban railway, and the manner in which they operate has been the occasion of much favorable comment. Each truck has two 15 horse power motors. The first one was on the road early in August, and was used under a large open car, and frequently carried up the heaviest grades a load of seventy-five people, and on several occasions more than 100 people. The truck was afterward put under a heavy Pullman car, which, without passengers, weighs almost as much as an ordinary street car when loaded, and its operation was equally satisfactory. This road is one which has many curves and heavy grades, and the motors are called upon to do very heavy work; but they proved themselves to be perfectly reliable, and abundantly able in every way to supply the demands made upon them.

The Sperry Light & Power company, Chicago, has been incorporated, to establish, maintain and operate electric light plants; incorporators, Samuel P. Parmly, Charles E. Gregory and Elmer A. Sperry; capital stock $100,000.

High and Low Tension Arc Light Systems.

BY E. P. [illegible]

A good deal is said in favor of high or low tension by the advocates of the respective systems. Of course, an agent of an electric light company always claims that his light is much lighter than the other fellow's light, but the reasons given for such statements do not stand except before some town councils. The object of this article is to investigate for the benefit of purchasers, without prejudice, the advantages and disadvantages of each system. In order to do this systematically we give in the following a list of the advantages and disadvantages as claimed or admitted by the sellers of those two kinds of apparatus. We consider only systems employing a continuous current, and in which the arc lamps are arranged in series, these systems being the only commercial systems in the United States:

[illegible]	[illegible]
[illegible]	[illegible]
[illegible] ame per- [illegible]	[illegible]
4. [illegible] ance of system required.	4. [illegible] ance of system required.
5. No danger to life if properly put up.	5. Less danger to life
6. The arc is silent.	6. The arc hisses.

First. *Amount of light per horse power:* The commercial arc lamps are generally said to be of 2,000 nominal candle power. This term really means nothing. No scientific test has been published yet which was not objectionable for many reasons. It is most difficult to measure accurately the candle power of an arc light, and agents do not run any risk in guaranteeing the candle power, as it will be almost impossible to

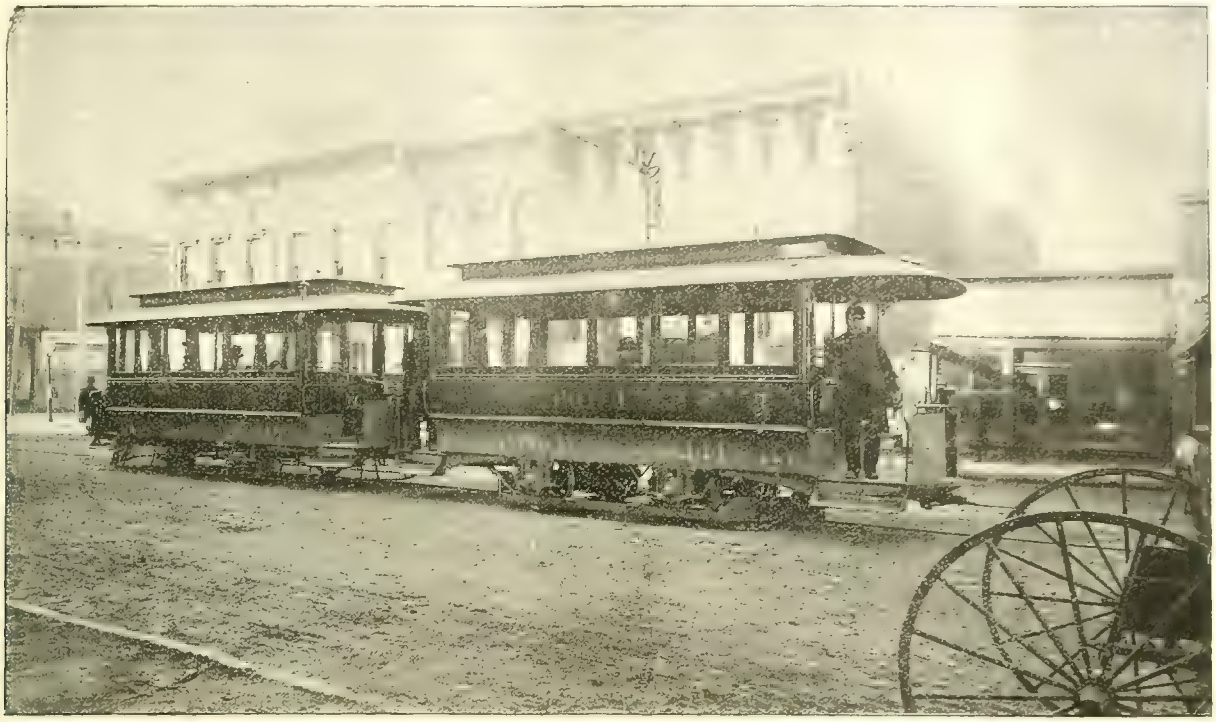


FIG. 1. THOMSON-HOUSTON ELECTRIC RAILWAY SYSTEM—MOTOR CARS ON THE COUNCIL BLUFFS ROAD.

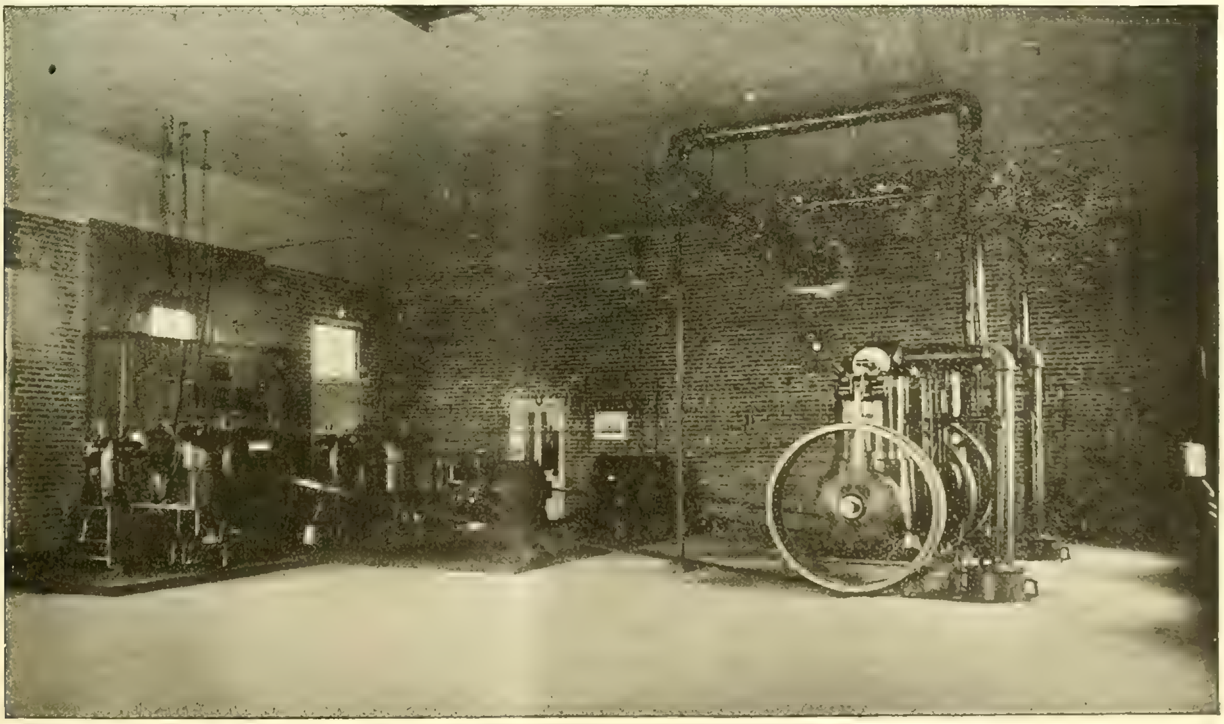


FIG. 2. THOMSON-HOUSTON ELECTRIC RAILWAY SYSTEM—POWER STATION IN COUNCIL BLUFFS.

the purchaser to ascertain whether the light comes up to the standard or not. In an article [illegible] tion of electric lamps (WESTERN ELECTRICIAN, December 3, [illegible] that a good nominal 2,000 candle power arc lamp measures horizontally about 250; at an angle of 37 with the horizontal about 2,000, and on an average (mean spherical candle power) about 450 normal candles. Without the knowledge of the actual candle power of the arc lamps, it is impossible, of course, to say whether the total amount of light in a certain system is produced by more or fewer mechanical horse power. The agents guarantee so many nominal 2,000 candle power lamps for so many horse power, and that is all. There is [illegible] reason why a high tension system should require more horse power for a given amount of light than a low tension system, or vice versa. Let us compare two existing systems—the high tension system to be of 10 ampere current and 45 volt e. m. f. per lamp and the low tension system of 18 ampere current and 25 volt e. m. f. per lamp. The electrical horse power expended in the arc is found by multiplying the volts with power of the greater volume of the short arc must naturally be greater than that of the long attenuated arc, just as the diffusing power of a 16 candle power gas burner is greater than that of a 16 candle power incandescent lamp. In one case we have the large radiating surface of the gas burner, in the other the small, thin incandescent filament. Look at a low and a high tension arc lamp of so called 2,000 candle power each. Let the distance be 2,000 feet from your point of observation in different directions, and you will understand the meaning of the term "diffusing power."

As to the steadiness of the arc, there are certain makes of dynamos and lamps in both systems which give perfect satisfaction. The advocates of each system claim that the slight impurities in the carbons, which produce an almost constant tremor in the other fellow's lights do not sensibly affect the steadiness of the arc in their own lamps. Each has reasons to present, and both are probably correct.

Third. *Cost of Copper in Conductors:* The loss of energy in a wire equals the square of the current multiplied by the resistance of the wire, or $\frac{E \times K}{C}$ where E is the total e. m. f. of the circuit in volts, K a constant, and C the current in amperes. Let us take an example: The insulation resistance for 30 lamps with 45 volts and 10 amperes would equal $\frac{45 \times 30 \times K}{10} = 135$ K

With 30 lamps, 25 volts and 18 amperes, the insulation resistance would be $\frac{25 \times 30 \times K}{18} = 41.66$ K.

Or in words, the insulation resistances of the two systems should be in the ratio of 135 : 41.66 or 3.24 : 1. In fact, the insulation should be 3.24 times better, or more expensive in the high tension than in the low tension system to make it stand the increased strain.

If we compare these figures with those for the cost of copper (sub. 3), we find that the amount of copper for conductors, all conditions being the same, in the low tension system is 3.24 times higher than in the high tension system, while the necessary insulation resistance required for the low tension system is 3.24 smaller than in the high tension system. The same percentage

FIG. 3. THOMSON-HOUSTON ELECTRIC SYSTEM—MOTOR CAR ON THE OMAHA AND COUNCIL BLUFFS BRIDGE.

the amperes; this is for: High tension = 10 x 45 = 450 watts; low tension = 18 x 25 = 450 watts. Seven hundred and forty-six watts equal [illegible] electrical horse power. Whether these 450 [illegible] expended in the arc give more illuminating power in one system than in the [illegible] satisfactorily proved. The commercial efficiency of the dynamo can be [illegible] higher or lower [illegible] system, and this fact is no [illegible] a judgment in favor [illegible]

[illegible] *Quality and color of light:* The dif- [illegible] between the light from a long [illegible] sion) and that from a short arc (low [illegible] While the long arc [illegible] says, the short arc [illegible] fter, mellow light, more re- [illegible] the long arc [illegible] The copper [illegible] f the arc.

[illegible] illumination according [illegible]

written in symbols in the form of an equation: $W = C^2 \times R$ in which W is the work or loss of energy in watts in the wire, C the current in amperes, and R the resistance in ohms. The following table illustrates the loss in each system:

WATTS LOST IN 10,000 FEET OF CIRCUIT.

Wire B. & S. Gauge.	10 Ampere System.	18 Ampere System.
6	411	1332
5	326	1056
4	259	839

In fact, the ratio of weight or cost of copper for conductors in the two systems on the same percentage of loss is as $C^2 : C_1^2 = 10^2 : 18^2$ or = 100 : 324. Or in words, if we want to lose the same amount of energy in a circuit of given length in each system, we must spend for every $100 for copper in the conductors in the high tension system, $324 in the low tension system.

Fourth. *Insulation Resistance:* The total e. m. f. for a certain number of lamps equals of course the number of lamps multiplied by the e. m. f. required for one lamp. For instance, for 10, 45 volt lamps it would be 450 volts, while for 10, 25 volt lamps it would be only 250 volts. The higher the e. m. f. in a circuit, the greater of course [illegible] between wire and earth. Hence for a given number of lamps there should be [illegible] insulation in the high tension than in the low tension system. To [illegible] the same in both [illegible] should equal

we gain or lose in the amount of copper, we lose or gain in the amount of insulation required.

As far as running expenses are concerned, it makes no difference whether we lose a certain percentage of power in overcoming the resistance of the wire, or whether we lose it by leakage through insufficient insulation. A company running quite a large number of arc lights on underground wires operated a number of low tension lamps on certain circuits. For some reason they changed the low tension for the high tension circuits. In a very short time the insulation of the underground conductors gave out, a result due to the increased strain which we showed must have been over three times greater than with the low tension system. The same experience was repeated quite a number of times.

Fifth. *Danger to Life:* The higher the e. m. f. in a given circuit the greater is the danger. For a given number of lamps the advantage, of course, is on the side of the low tension system, or in other words, we can run a larger number of low tension lamps with equal safety on the same circuits. It cannot be said, however, in a general way, that the low tension system is less dangerous than the high tension system; it depends entirely upon the total e. m. f. in the circuit.

A circuit of fifty low tension lamps, with a total e. m. f. of 50x25=1,250 volts, is more dangerous than say a circuit of twenty *high* ten-

sion lamps with a total e. m. f. of [illegible] =900 volts. The relative danger between high and low tension circuits can, of course, be reduced to a certain extent by increasing the insulation resistance of the high tension system proportionally. Still, to the persons who have to handle unprotected parts of the circuits, as lamp trimmers, dynamo tenders, etc., the high tension system will be relatively more dangerous.

The danger to human life, however, lies not only in the relative height of the e. m. f., but there are other considerations. The character of the current has, for instance, a good deal to do with it. Pulsatory or intermittent currents will be more dangerous than currents of a more continuous character. Circuits fed from series dynamos will probably be more dangerous than those fed from shunt dynamos, etc.

Sixth. *Hissing of the Arc:* It is generally admitted that short arcs hiss, while long ones (above a certain potential) are almost silent, when the lamps are kept in proper adjustment. The hissing of the low tension lamps is certainly an objection in a good many cases, for instance, in rooms with low ceilings; for the illumination of streets or large halls it does not cut any figure.

It will be seen from this examination that both systems have advantages and disadvantages, and it may be that while one system could give perfect satisfaction under certain circumstances the other could not. It is the duty of the purchaser to ascertain which system will better suit his taste, and more successfully meet the conditions under which it is to be installed. Both systems can give, and are giving, perfect satisfaction in many places.

By giving this matter an honest consideration, both purchasers and sellers will be benefited. We give in the following a short resumé of the advantages and disadvantages of both systems, not as they are claimed by the selling agents, but as they appear to an unbiased observer.

RESUME.

High Tension.	*Low Tension.*
1. Less cost of copper conductors for same percentage of loss of energy.	1. Higher cost of copper conductors for same percentage of loss of energy.
2. Higher insulation resistance required.	2. Less insulation resistance required.
3. More dangerous to life.	3. Less dangerous to life.
4. Color of light, mixed with blue and violet rays.	4. Color of light, white and mellow.
5. Arc is almost silent.	5. Arc hisses.

The Western Electric company has sold to the Webster & Comstock Manufacturing company, Chicago, a 100 light incandescent plant.

The Steam Engine Its Principles, Its Development, Its Present Capacity, and Its Future Perfection.[1]

[illegible]

In the year [illegible] our great countryman [illegible] Henry, [illegible] the [illegible] discoveries [illegible] netism in this country, after a series of [illegible] ters of the principles of electricity, predicted [illegible] electricity [illegible] to man, and prophesied [illegible] tur[illegible] would be made which [illegible] perfect [illegible] and valuable. At that time [illegible] produced only [illegible] in galvanic batteries, and Prof. Henry pointed out that so expensive a fuel as zinc could not compete commercially with coal for the generation of power, and that [illegible] the electro-motor must be limited in its uses to cases where some special convenience would compensate for the increased expense.

In 1831 Prof. Henry in this country and Faraday in England, almost simultaneously, but independently of each other, discovered that electricity could be produced in indefinite quantities by the combination of horse power with a magnet; and electricity thus produced was called magneto-electricity. This, the greatest of all the discoveries in electricity, opened the door to an unlimited application of power for its production, and it was left to ingenious electricians to invent forms of apparatus by which, in the most effective and economical way, the desired result could be accomplished.

[illegible]

FIG. 4. THOMSON-HOUSTON ELECTRIC RAILWAY SYSTEM—MOTOR CAR ON THE COUNCIL BLUFFS AND OMAHA BRIDGE.

The most important movement, and which has practically superseded all others in the devices for developing the principles established by the discoveries of Profs. Henry and Faraday, was made by Pacinotti, whose apparatus, modified subsequently by ingenious inventors, is now in universal use, producing practical results so near to the theoretical ones that more than 90 per cent. of the power expended upon the generating machine reappears in the form of electricity, leaving less than 10 per cent. to be saved (if it can be saved) by other improvements. So far as we know, this whole system depends upon the steam engine; and it must continue to depend upon that means for generating power until, in the future, the discovery shall be made of some means of converting the heat of combustion directly into electricity without the intervention of any other agency. When that is done—and it is entirely within the laws of nature—then the steam engine will disappear in connection with the generation of electricity.

The first steam engine of which we have any knowledge (although indeed, if the records had not perished we should have known much more on the same subject) was made by Hero, of Alexandria, more than two thousand years ago. It was a perfectly practical operative machine, and has been in use within a very recent period for the purposes of driving sawmills. Its principle is that of tangential reaction—the steam escaping tangentially at the periphery of a revolving wheel. Shortly after Hero's date, the progress of science and art, which had been very great in Alexandria, was arrested by the flood of ignorance and superstition, which for ages chained down the intellect of man; and until Lord Bacon shed the light of his genius upon the world, philosophy and religion were united in despising the practical arts of life, by which the physical condition of humanity is improved, and as a consequence, its intellectual capacity developed.

Under the new impulse the steam engine again appeared, but was used chiefly for the purpose of pumping water, city, in 1842. He invented the "indicator," an instrument which gives us a graphic representation of the force exerted by the steam, and proves the truth of the laws he discovered.

He invented the "single poppet valve" for admitting and excluding steam from the engine, which if theoretically perfect, and without which it is almost impossible to make an engine give the full value of the steam used in it. There ought to be a statute in the interest of humanity requiring all engines to use it when the rate of speed is not so high as to compel the use of the inferior slide valve; in the interest of humanity, I say, because it would save a vast amount of coal in the ground for future generations. He invented the steam jacket to surround the cylinder with an envelope of hot steam, in order to preserve the heat of the steam within, while expansion is occurring and giving out power. He invented the "fly-ball governor" for maintaining uniform speed of the engine under varying conditions of load and pressure.

When he died he seems to have left no successor capable of appreciating the discoveries he made, and for a generation after his death the art of producing power from fuel by the intervention of a steam engine retrograded, so that less power was obtained from a pound of coal consumed than could be obtained by the use of methods invented and fully explained by James Watt.

The problem of the steam engine is to convert the potentiality of combustion into dynamic energy, and that steam engine is the best which can obtain the most power from the least coal. In the eternal cycle which [illegible] began, force in a protean form remains constant; and whether it is applied to the uses of man, or whether it is expended in some useless or [illegible] effect, depends upon how nearly imperfect man can [illegible] the laws of nature in dealing with it. You, gentlemen, are dealing with one form of force which has eluded thus far all investigations into its substance, but it is [illegible] section in the cycle and is necessarily coupled to what precedes and what succeeds it, under the immutable laws of the correlation of energy.

When the great Creator, in the construction of this

[1] Abstract of paper read before the New York Electric Club, Jan 17, 1889.

world, separated the carbonic acid of chaos into its two constitutents and stored away the carbon for the uses of man, while the oxygen was liberated in the envelope of the earth, ready to again combine with the carbon, and again produce the force which had been expended in disuniting them, the problem presented to imperfect man was the production of so much force, by again uniting these dis-

FIG. 5. THOMSON-HOUSTON ELECTRIC RAILWAY SYSTEM—ROAD AT WASHINGTON, D. C.

severed elements, as had been expended in separating them. The plain injunction given to him is—be economical of these resources, for they are limited. The coal deposits when once exhausted cannot be renewed; and the existence of civilization on the earth in its present form depends upon the supply of available carbon.

The first fact to be discovered, is the amount of power which is inherent in the reconversion of carbon and oxygen into the carbonic acid form in which they formerly existed. In round numbers it may be said that a pound of good coal perfectly consumed can produce heat enough to convert about fourteen pounds of water into steam, but it varies with the quality of coal. The best boilers will convert about ten pounds of water into steam with a pound of coal burned; so that the loss in that step is not very great.

The next fact to discover is the amount of force which results from the conversion of water into steam. That fact is fixed, and can neither be increased nor diminished by man's ingenuity or efforts. As a convenient unit to remember, and near enough to the truth for all practical purposes, a cubic inch of water converted into steam by whatever means, or under whatever circumstances, will [illegible] 2,240 pounds one foot high. Beginning on that base line, in the direction of the boiler, it becomes [illegible] to [illegible] organize it as to obtain the greatest evaporation from the fuel burned, and to lose the least amount of heat. In that direction very great perfection [illegible]. A practical and good boiler will evaporate about 70 per cent. of as much water as the fuel [illegible] of evaporating, if there were no part [illegible] otherwise than upon the water, and there is but little left to save. In the other direction, [illegible] more difficult. If the [illegible] to use simply the [illegible] from the water then, [illegible]sly, the whole effect possible to be produced would [illegible] that the [illegible]

to be derived from permitting steam to expand after it has been used for all that it is worth as it comes from the water. Without refining, a few figures will be instructive. If the steam be a[illegible] to expand into twice its original volume, it will add [illegible] per cent. to its [illegible] power [illegible] a ton a foot high [illegible] one ton [illegible] high for each cubic inch of water. If it be allowed to expand three times, it will lift two tons a foot high. Ten expansions will lift three tons and $\frac{3}{10}$ a foot high. One hundred expansions will lift five tons and $\frac{6}{10}$ a foot high; and obviously, all the weight lifted beyond the original ton a foot high is clear gain, by applying the principle discovered by James Watt.

FIG. [illegible] ELECTRIC RAILWAY SYSTEM—[illegible] CAR ON THE ROAD AT WASHINGTON, D.

Then [illegible] steam which James Watt [illegible] which is, in [illegible] to evaporate a [illegible] than is needed to [illegible] pressure, or any other [illegible] but it requires the [illegible] to detect the varia-

tions; and those experiments were made by Regnault, the French scientist, under the auspices of the French government forty years ago, who finally determined the exact truth, which does not practically vary from the formula of James Watt and Dr. Bl[illegible] associate.

Those of you who were educated more than thirty years ago will remember that the text books stated that "the sum of the sensible and latent heat of steam was constant," which was believed to be true by James Watt. The fact is that a very little more heat is required to evaporate water under high pressure than under low. Regnault's equation shows the addition to be 3–10 of the sensible temperature, and it may be disregarded for all practical purposes in calculating the power of the steam engine.

Under this law, therefore, the higher the steam is carried, the lower the range of expansion can be carried without reducing the pressure below the point at which it is practically efficient, and hence the advantage of carrying high steam; but there is no advantage in carrying high steam unless it be accompanied by long ranges of expansion; on the contrary, there is a loss, because it is more likely to leak, and is more destructive of machinery.

These three laws are the key to the whole problem:

FIRST—A cubic inch of water will lift a ton a foot high converted into steam;

SECOND—It costs no more fuel to evaporate a cubic inch of water at the pressure of 200 pounds to the square inch than it does to evaporate it in an open vessel; and

THIRD—The gain of power depends upon the number of times the compressed steam is permitted to expand after it has done the work of lifting a ton a foot high.

Founded upon these principles, the steam engines which were made by Mr. Watt and his associates and pupils before 1830, produced a horse power with less than two pounds of coal an hour. These engines are known as the Cornish pumping engines; and if you will look into the history of these machines you will find them reported as doing a "hundred millions of duty;" which is a technical phrase intended to express the fact that a hundred millions pounds of water were lifted a foot high for a hundred weight of coal consumed. Turning that into horse power, it means about two pounds of coal an hour a horse power. This result was produced by cutting off steam in the cylinders at one eighth or one-tenth of the stroke, and allowing it to expand eight or ten times. The engines of that day, of course, were very imperfectly constructed, and great losses occurred from leaking pistons and from imperfectly constructed boilers; but notwithstanding that loss, the result was equal to two pounds of coal an hour a horse power.

Executing the drawings of these engines with the tools and machinery of to-day and the result would be appreciably higher. Or, in other words, an engine expanding steam ten times, and evaporating eight pounds of water to a pound of coal in the boiler, and without any losses from leakage, ought to make a horse power with a pound and a half of coal an hour. These results were obtained by obeying Watt's laws, which I have stated, as nearly as it was possible then to do.

Obviously, two conditions are essential to a perfect obedience of these laws:

FIRST—The valves of the engine must be absolutely tight when closed; and

SECOND—The closure of the steam valve, when the time for cutting off has arrived, must be instantaneous.

With these two conditions, the engine in other respects being practically perfect, the theoretical conditions will be practically attained. But in proportion to the defects in

those conditions the losses will increase. James Watt complied with these conditions in respect [illegible] by making them absolutely steam tight. They were what is called "single poppet valves"—that is a tapering plug fitting into a tapering hole with the steam pressure on the upper side. When the plug is ground into the hole then the heavier the pressure upon it the tighter [illegible] its. When it is open the steam flows through. When it is shut, then the steam is absolutely excluded.

The next element is more difficult to perfect. In James Watt's machines these single poppet valves were closed as rapidly as mechanism would endure, by the mechanical movement of the engine itself. But unless the valve is closed instantaneously the steam is "wire drawn" through the contracting aperture while the piston is running, and as a consequence a great loss of power results.

More than forty years ago Mr. Sickles, then an apprentice in the Allaire Works in this city, invented an instantaneous closing valve, which he did by detaching the valve from the lifting mechanism, driving it shut with high speed, and arresting its fall at the instant of closure by confining a fluid in a cup; and inasmuch as water or air can be pounded forever without injury, no destruction resulted. This improvement perfected the mechanism for carrying out James Watt's laws. It was adopted afterward by Corliss and most other stationary engine builders, and is the only reason for the improved efficiency of that class of engines.

It is the only radical improvement in the steam engine which has ever been made since James Watt left it.

We now hear much of double expansion or compound engines as if they were a novelty, and as if there were some mystery about them. They were perfectly well known to James Watt, and several patents upon them were taken in England, by Wolf and others, in the early part of this century. Their improved efficiency depends simply upon the fact that the steam is allowed to expand through two or three cylinders, whereby a greater range of expansion can be obtained than can conveniently be had in a single cylinder. But no greater effort can be obtained than is due to the expansion of the steam under the law discovered and stated by James Watt. Much less than that is obtained in practice in these engines, because of the losses incident to the transference of the steam from one to the other of the cylinders.

In 1825 several steamboats on the North River, worked by double expansion engines, were built by Mr. Allaire in this city—the Henry Eckford for one, and the Sun, which made the trip to Albany in about twelve hours, for another. At that time the subject was not well enough understood, and economy in fuel was not considered of so much consequence as the first cost of construction, and these engines were not largely reproduced. One of these double expansion engines made in England was brought to this country in 1830, and for many years was used in the oil factory of Judd's Sons giving very economical results.

When steamships came to be built in England in 1840 and afterward, notwithstanding the fact that high expansion with great economy was in constant operation on James Watt's Cornish engines, and on Wolf's compound engines, no attempt was made to work the marine engines under high expansion; and as a consequence all the earlier steamships, for more than thirty years, were running at a cost of at least four pounds of coal an hour a horse power; while, at the same time, compound engines had been well known for a generation and were in actual use, making a horse power for about two pounds of coal an hour. The fuel account was enormously expensive.

This condition of things continued until about 1860 when Mr. Jameson, an English engineer in charge of the steamships of the South Pacific Steamship company, which was losing money because of the great price of coal at Panama, induced his company to send one of their ships to England and replace its engine with a double expansion engine. The improvement of course was enormous, and all of those ships were sent round the Horn to England and fitted with high expansion engines, thereby converting a losing into a profitable business. This experience astonished the English steamship owners; and the White Star Line began to use compound engines, which has been followed up from that day to this; and now they are running about as economically as James Watt's engines were running more than half a century ago; that is to say, at the cost of two pounds of coal an hour a horse power.

Some of the more recent engines, carrying expansion still further, have reduced their fuel somewhat below that mark; and of course as expansion increases the consumption of fuel will diminish.

In this country the early steamboat engines adopted James Watt's single poppet valves, which are absolutely perfect for a steam engine, but they did not have the cut-off of James Watt, although they used another kind, and therefore did not get the full results of Mr. Watt's plans. Their single poppet valves, however, were of immense value; and Commodore Vanderbilt, who was a very keen observer and a very able man, told me that he had observed that his old steamers on the North River produced power with less fuel than his improved modern steamers, which was undoubtedly true—the reason being that the modern steamers abandoned the single poppet valve of Watt, and substituted for it what is called the balanced valve. The astonishing fact exists to-day that on an average every steamboat running on the waters of New York is wasting certainly not less than fifteen per cent. of all the fuel consumed by leaking through the valves; and almost any one of them will run at the rate of four or five miles an hour without even opening the steam valves at all, and simply by the leakage through those valves; and that leakage is the difference only between what leaks in through the steam valves and what leaks out through the exhaust valves. This tremendous loss is not appreciated, because it is a case of internal hemorrhage and no visible sign appears. The steam leaks into the condenser, and is pumped overboard with the condensing water. The remedy, of course, is very simple, and that is to go back to

[illegible] Watt [illegible] would mean [illegible]

[illegible]

[illegible] James Watt [illegible] of the United States [illegible] more [illegible]

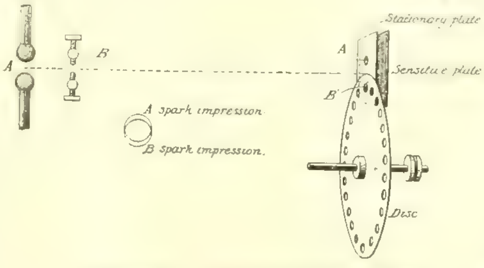
[illegible] quence of some experiments ignorantly tried by the government [illegible] engine [illegible] the tables showed, was using more than twice the fuel to the horse power than James Watt's engines were using. What was proved by the experiment was that such a machine as that was not a good one to work expansion on; but it was assumed that it proved there was no use in expansion.

Upon that principle the whole steam navy of the United States that was built during the war was constructed. This was a tremendous blow to progress, from which we have not yet entirely recovered; and but for the fact that the engineers of Europe have built their magnificent steamers, and carried expansion to a high degree, we should have been building a navy to this day in accordance with this ignorance. But James Watt, for a dead man, made a magnificent fight in defence of his principles; and the money and resources of the United States have utterly failed to defeat him.

Another singular fact, connected with this performance and illustrating how far the authority of a great government is felt in the world, even when employed to disseminate the grossest errors, is that in the recent edition of the Encyclopædia Brittanica; in an article full of apparent learning, these experiments by the United States Govermment are cited as authority for the most absurd nonsense.

The new steamer *Vesuvius*, built by Mr. Cramp in Philadelphia for the Government, and exhibiting higher speed than any similar vessel known, expands its steam seven times, and the performance vindicates the law.

In considering the question of economy in engines to be used for the generation of electricity, it is to be remarked that on account of the first cost, and the difficulty



PHOTOGRAPHIC STUDY OF SELF-INDUCTION.

of always obtaining condensing water, the so-called high pressure engine has to be largely relied upon for generating power. That is only partially a steam engine. It is driven by steam on one side of the piston, but it is resisted by the atmospheric pressure on the other side; and consequently there is a constant back pressure of fifteen pounds to the square inch, which has to be driven out and paid for in fuel without any beneficial result on the work to be done; and, therefore, high economy cannot be obtained in a non-condensing engine; whereas in a steam engine proper the back pressure may be reduced to one pound to the square inch and, therefore, it forms a very small proportion of the total work done, leaving a much larger proportion for useful effect. Whenever, therefore, the conditions permit it, a condensing engine should be employed, out of which the maximum economy can be obtained.

The present efficiency of the best non-condensing engines is probably not greater than at the rate of two and a half pounds of coal an hour a horse-power, and of a good condensing engine about two pounds of coal an hour a horse-power, or not materially different from James Watt's engines of fifty years ago. At the rate of two pounds of coal an hour a horse-power, the engine is developing about one-tenth of the power which the coal is giving out in combustion, and nine-tenths are lost; and the question is, what are the limitations upon the steam engine beyond which practically it cannot be expected to pass in diminishing the consumption of coal in comparison with horse-power? The enormous loss which I have mentioned is due to the fact that the steam in steam engines can be expanded only to a very limited extent. The temperature of combustion may be taken at 2,000 degrees, but the water and steam on the opposite side of the thin boiler plate which separates them from the fire may be only 350 degrees hot, which represents 125 pounds to the square inch, whereas, if material could endure the temperature, and boilers could be made to bear the pressure, steam might be carried at 1,000 pounds to the square inch, and the temperature at 550 degrees, and it would cost a very little more fuel to make the steam at a thousand pounds pressure than it costs to make it at the atmospheric pressure. At the pressure of a thousand pounds to the inch the steam might be expanded one thousand times, giving eight times as much power as when used without expansion. But practically this cannot be done because material will not endure the heat, the pistons cannot be kept tight, and a little leakage of such valuable steam would destroy the economy. Perhaps the limit to which pressure can be carried practically, with our present knowledge of material and of construction, is 250 pounds to the square

[illegible] engine [illegible] hour, if [illegible]

American Institute of Electrical Engineers.

[illegible]

[illegible] the following discussion took place:

THE DISCUSSION.

Dr. Otis A. Moses: I have had [illegible] opportunity of knowing the careful methods in which Mr. Acheson directs his thought experiments. He has [illegible] with me occasionally on the subject in the course of [illegible] experiments. If Mr. Acheson will look at Fig. 2 in the various experiments with the Leyden jar [illegible] where he has a wire coiled around the metallic coating [illegible] the conductor, he has substituted there a supplementary coil of two or three turns, and has brought the terminal of it to a certain distance from the interior conductor. He has done that, as I understand, as a substitute for the wire *W*, in both cases making the air space the same. Will Mr. Acheson please report what was the object of that substitution, so that I may direct another question afterward?

Mr. Acheson: The doctor is mistaken in regard to its being the equivalent of the wire *W*. In order to ground it I have assumed that the outer surface of the jar *J* represents the earth, and I connect the outer surface of the lead to that by a short metallic connection in order to reduce it to one potential, as we would have it in practice.

Dr. Moses: Were the lengths of the two wires different, the one wrapped around the lead coating and the wire *W*?

Mr. Acheson: The wire *W* has no relation to the wire *E*.

Dr. Moses: What is the relation? That is what I would like to know.

Mr. Acheson: I see now that you mean to ask if in this Fig. 2 the lengths *E* and *W* are the same.

Dr. Moses: Yes.

Mr. Acheson: No, sir. The coil of the wire *E* about the lead in this case was probably accidental in the sketch, because in reality it was only one turn around it, so that there was no parallel effect there.

Dr. Moses: There was another point that I would like to be enlightened upon. You mention in one case that you experimented with copper and iron wire, and used wires of the same diameter in both cases. Did you take into consideration at all the conductivity of the wires, or did you think that unimportant?

Mr. Acheson: I made no measurements whatever of the conductivities.

Dr. Moses: You simply considered the surfaces to be the same?

Mr. Acheson: Owing to the existence of that air space I assumed it was wholly useless to consider the resistance of the wire, as we had an infinite resistance already in the circuit, I mean in the space *A*.

Dr. Moses: In that space *A* did you consider the difference in the size of the condensing surfaces of *X* and [illegible]

Mr. Acheson: Yes; I attempted to make a measurement of the capacity of the apparatus with the jar removed; but although I had a constant on the galvanometer of a very high constant—I failed to get any capacity, [illegible] there was none there, for we knew that there was, but it was beyond the reach of my instruments. The size of the balls was considered, of course, and the ball *X* was made of a size that would allow me to obtain a [illegible] electromotive force without spinning off, as it would do where it was very small.

Dr. Moses: By what means did you cause your rotations?

Mr. Acheson: By hand. I used [illegible] son's sewing machine as the motive power. In Plate number 13 I shifted the position of the [illegible] revolving disk remaining in its former position [illegible] being here rotating in relation [illegible] tive plate, and in order to produce this first spot marked 1 I had the plate in a certain [illegible] the succeeding ones twice.

Dr. Moses: Has it ever struck you that [illegible] experiments might have great bearing [illegible] brushes of dynamos. By inserting [illegible] brushes, coping the brushes together [illegible] them first in contact, so as [illegible] it would be a very interesting [illegible] upon. Your power there [illegible] the spark [illegible] be you to avoid the spark on [illegible] dently from the same cause. In the [illegible] Professor Hughes described these experiments [illegible] you refer, he indicated that there might be some [illegible] in the metals that were used [illegible] experiments carried on in this [illegible] direction, but it seems to me it would [illegible] field of investigation to find out whether [illegible] brushes, perhaps of iron and copper [illegible] to eliminate the spark from the dynamo [illegible]

[illegible]

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F. B. BADT, in an article in this issue in a clear, concise way, sets forth the relative advantages of high and low tension arc light systems.

ELECTRIC light has been adopted on another [illegible] ad entering Chicago. The service on the railways seems to be giving the utmost satisfaction.

THE Chicago city electric light plant is operating with the greatest success, and demands for the extension of the service continue to pour in on the municipal electrical department.

[illegible] is to be lighted by [illegible] period during its trips [illegible] without electric [illegible] f the current could be employed for [illegible] ell as illumination, the result [illegible]

[illegible] read by E. N. [illegible] New York [illegible] sue. The subject [illegible] The history of the [illegible] in Western [illegible] n of the paper.

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be noticed in an article which appears elsewhere, a large number of manufacturers have already made arrangements to make exhibits. The committee will within a short time assign space for those who have made applications. The committee is hard at work arranging for a number of novel features which will give additional interest to the electrical exhibition.

THE discussion of E. G. Acheson's paper on "Lightning Arresters and the Photographic Study of Self-Induction," which appeared in the WESTERN ELECTRICIAN of last week, by members of the American Institute of Electrical Engineers, is given in this number. The liveliest interest is manifested in the paper, in which Mr. Acheson so ably summed up the results of his careful series of experiments.

IT is stated that the English committee which has crossed the Atlantic to investigate the affairs of the Electric Sugar company still has faith in the mysterious refining process. What the basis of this faith may be is not disclosed. American stockholders have utterly lost confidence, and it is feared that the representatives of the English investors will be equally disconsolate when their mission of investigation is completed.

A REPRESENTATIVE of the Brass Manufacturers' association was in Chicago last week. He made the statement that a break in the copper market was confidently looked for, as it was believed the syndicate had found its load heavier than it anticipated. Coming from a well-informed gentleman this statement is interesting. So many prophesies of this kind have been made that one is inclined to believe that the wish in this case is father to the thought.

THE New York correspondent this week gives considerable interesting information concerning several large central stations in the metropolis. The plants are splendidly equipped, and will give New York an almost unequaled service. The same correspondent refers to several ornamental designs employed in the arrangement of incandescent lights. This is a field in which much good work has been done, and in which there is an opportunity to accomplish still more.

CHICAGO is enterprising, and has seen the accomplishment of a number of difficult electrical tasks, but too much credit is given to the city in the following paragraph from the London *Electrical Review*, which is news indeed: "The printing establishments of Chicago have introduced a novel form of electric lighting. Each workman carries a headdress which contains an incandescent lamp, and a small cell capable of giving ten hours of lighting without being recharged. The whole apparatus only costs about $2."

THE London *Electrical Review* in a leader in which it considers at length electric executions, comes to this conclusion: "We see no objection to this mode of execution, except so far as objection can be made to execution altogether, and we see no insuperable difficulty in the way of its adoption. It is needless to specify the various methods adopted elsewhere for carrying out the death sentence, or to give in detail the objectionable elements in each case. They will present themselves to the mind of the reader, and if he be fair-minded, we think he will ultimately incline to our way of thinking, namely, that so long as capital punishment obtains, death by electricity is the least revolting form which it can assume. No bloodshed; no horrible struggles or contortions; no bungling half hanging through the swelling of timbers; but death, swift, sudden and painless: one moment the man is, the next he is not." In this connection it may be interesting to note that [illegible] newspaper agitation [illegible] in New York state concerning that [illegible] electricity for the [illegible] reports of execu[illegible] and the mere statement

of fact. Several of the leading papers claim that this provision is clearly unconstitut[illegible]. It is also held that [illegible] the right of the p[illegible] to ascertain definitely whether the new mode is more humane than the old, and that the requisite information can only be furnished by the press. It is asserted that the leading newspapers throughout the state have determined at the first opportunity to put the question to the test.

CONSIDERABLE space is devoted this week to the report of the discussion of the question of insulation by members of the Chicago Electric club. It will be noted that the topic is considered in a highly practical way. After two hours of discussion a formula, by which the requisite insulation in all systems could be determined, was decided upon. The subject, however, has not yet been exhausted, and the topic will be discussed at future meetings. It is a question of the highest importance, and that the greatest interest is felt in it has been shown by the large attendance at the sessions.

AN article describing a successful electric railway system appears in this issue. Several cuts giving excellent views on the several roads are presented. The rapid extension of electric railways is marvelous. The systems have been in operation for a long enough period to demonstrate their complete reliability, and their eminent superiority over other modes of street car propulsion. That street railway managers throughout the country are beginning to believe in electric traction is amply proved in the correspondence columns of the WESTERN ELECTRICIAN every week. Those who were skeptical a few months ago have been obliged to change their opinions in view of the admirable working of electric motor cars under all circumstances.

A bill has recently been introduced in the Illinois legislature for the regulation of telephone rentals in the state. Its general provisions and a brief criticism concerning it by an official of the Chicago Telephone company, are given elsewhere. While in its main features the bill is a copy of measures in other states it is more sweeping. It contemplates a reduction in rates, which in Chicago would make the receipts of the company about a third of the present income. No one anticipates the passage of an extreme law of this kind, and the introduction of the bill excites no sort of alarm in Chicago.

In Kansas City the warfare against the company is prosecuted vigorously in spite of all propositions of the company to demonstrate by its books that the charges are fair, and that the corporation is making but a small percentage on its investment. A committee of citizens is now looking over the affairs of the company to ascertain whether the corporation has been making too much money out of the residents of Kansas City.

Reference is made elsewhere to the bill before the Missouri legislature regulating telephone charges. The bill is the outgrowth of the controversy at St. Louis, which recently resulted in a victory for the company over the city, which had attempted to regulate rates. The company now protests that it cannot continue business on the terms proposed by the legislature. Should the bill pass and an effort be made to enforce it the company says its only course will be to cease operations, and withdraw from the state. This would leave Missouri without telephones, a state of affairs which all enterprising business men would greatly regret, and it would undoubtedly have a depressing effect upon business, as capitalists would not feel like investing their money in business where it is liable to be ruined through state interference. Another result, and one that would be widely felt, would be the withdrawal of employment of the operators, linemen, etc., now connected with the telephone companies. When such vast interests are at stake legislators should move slowly and carefully weigh the consequences of their actions. It is needless to add that the conservative element in St. Louis and throughout Missouri vigorously opposes the proposed bill.

(Continued from page 47.)

E. T. BIRDSALL: Dr. Moses speaks of sparking from the brushes of dynamos.

DR. MOSES: You have heard the anecdote of the man whose lawyer told him he could not be put in prison on account of a legal technicality, and who wrote to his lawyer saying that notwithstanding that, he was actually in prison. I think if he looked, even without a microscope, at the brushes of the dynamo machines he would find sparks.

LEONIDAS L. HAMILTON: One question arises in my mind, whether or not the ghost, so called, in the photograph might not have been caused by a difference in the revolution of that disk. It seems to me that the experiments, with no possibility, as I can understand it, of accuracy as to velocity of revolution, might possibly result in this ghost filling the plate.

MR. ACHESON: I neglected to state the manner in which the disk was timed. I timed it always. Of course, I could not get an exact speed. These are not printed exactly like the negatives. While some of them exhibited a little or no ghost at all, others exhibited a length of as much as a tenth of an inch. Now, we know there is no difference in speed like that.

MR. HAMILTON: How did you control the speed?

MR. ACHESON: Well, it was pretty nearly the limit of my power. I had everything ready for the discharge of the jar, and held that in waiting until I had the speed up with my watch before me.

MR. HAMILTON: The photographs were each separate, were they not?

MR. ACHESON: That *A B* spot was made by one spark at the same instant of time. The spot *A* was produced through a stationary aperture, while the spot *B* was produced through the moving aperture in the disk. It was a question that I wanted to decide for my own interest to determine whether any vibration that might be introduced in the work would cause any movement of the outlines, and I always had the *A* spot for that object, so that I might have a means of comparison with the spot produced by the moving aperture.

LEMUEL W. SERRELL: I would like to ask Mr. Acheson if he developed the negatives all at the same time; that is, with the same developer, and gave them all an equal length of time in developing. This ghost, or tail, of a comet is a vanishing thing, and if the development was applied at different lengths of time it would make a different depth to the negative, and make a different length to the ghost, or to the tail.

MR. ACHESON: I am not a photographer by profession, and, in fact, I never did any photographing until I commenced this. I never had an instructor. Although I spoiled some plates, each and every one of them was developed separately, and it was all done after night. None of this work was done by daylight. Much of it was done in the neighborhood of midnight, or later, and as a rule, after considerable experience I developed them until they ceased to show any increase.

MR. BIRDSALL: In taking pictures on glass plates, such as Mr. Acheson took, although these probably do not exhibit that defect to any extent, a glass sensitive plate pointed at any bright object, and a picture taken of the bright object, will always exhibit this halo, and taking a picture through a hole like that, if the source of light were not perpendicular to the surface of the plate, it would exhibit that halo on one side. If the spark was not far enough away from the surface of the plate, so that both the holes *A* and *B* were practically in a perpendicular line, that property which is called halation of plates, and which is avoided in the paper negatives, would introduce probably an appreciable error, as in taking pictures with, say a 10-inch focus lens, we get a picture of the sun on a plate about one quarter of an inch in diameter, and there will often be a half inch of this halo around this image on the plate. If we take a picture of the sun through a large hole, it would in all probability show more halation on one side than on the other similar to these pictures, although that error may not be introduced in these.

JOSEPH WETZLER: There is one point that occurs to me in connection with Plate 5. Mr. Acheson remarked that when he applied an iron rod in that coil the spark was very much diminished. He attributed this at first to the magnetization, but when he inserted the copper he found the same diminution of spark. He then came to the conclusion that the retardation was due to the energy abstracted from the circuit by electric currents set up within the bar. It seems to me that that result of the equal action of the iron and the copper might have been predicated when we consider that it takes some time for iron to magnetize; in other words, the iron would not, as a rule, magnetize with a current of a static discharge on account of its great rapidity; that static discharge is practically instantaneous, while it takes some time for iron to magnetize—something in the neighborhood of one one-hundredth of a second, if I remember rightly. We might, therefore, conclude that the spark did not magnetize the iron, but was probably due to electric currents set up in the iron.

MR. ACHESON: I quite agree with Mr. Wetzler in regard to those opinions, and they are such as I finally formed. It was wholly due to the wonderful rapidity of the discharge, and the want of time for it. A gentleman brought up a question in regard to the possibility of a production of those ghosts due to the line of the ray of light not being perpendicular to the glass surface. At first I had some difficulty, and thought I had achieved success before I did owing to the fact that my two sparks and the hole were not in a direct line, and it caused a distinct overlapping of the outlines of the spark as produced in the spot very distinct and sharp. At first I thought it was a difference of time between the two sparks, that the spark was a little back of *A*, which was what I wanted, and I was much pleased; but it was not the case, it was simply due to the fact that they were not in line. The *A* spark was here (illustrating.) About this distance from it was the *B* spark, and in a direct line; as I say, I found it to be direct absolutely. This disk was mounted on bearings here. At this point was my plate. There was the [illegible] suppose, in there, [illegible] plate, [illegible] in front of the sensitive [illegible] not there. Now I divided the [illegible] so that [illegible] strike about midway [illegible] two. If I [illegible] it to strike one [illegible] tinct difference in the spots as can be seen [illegible] negatives [illegible] I tried to get them [illegible] under no conditions could I get the ghost [illegible] due to the [illegible] which were suggested [illegible] the spot *A*, but it is not there.

PROF. WM. F. GEYER: To what cause, Mr. Acheson, did you ascribe the ghost?

MR. ACHESON: It is due to the [illegible] current and the continuous charging and discharging of the condenser [illegible] which has to go through the [illegible] as illustrated in these figures, producing a spark [illegible] diminishing [illegible] and continuing for a certain length of time until that energy is expended in some manner. [illegible] the negatives you can see that the spark weakens and fades away until it actually disappears. You cannot give it a definite length.

PROFESSOR GEYER: I know of an analogous experiment which I think proves that the position you take is perfectly correct, and that it is not necessary to find photographic causes for the ghost. The experiment, I recollect, was one made by Professor Meyer of the Stevens institute, where a Leyden jar was discharged through the prongs of a tuning fork, at the end of which there was a little pointer which again moved over a rotating cylinder blackened with lamp black. When the Leyden jar was discharged there was made on that blackened paper one great blotch where the lamp black was dissipated. At this same distance further on, this cylinder rotating with uniform velocity, there was another blotch, and then there were three and four, and then there would be a moderate interval; then there would come a great group of them, and then another group, so that taking the trouble to count them there were actually several hundred of those discharges recorded, with no possibility of any photographic disturbance on this cylinder, showing that there were at least 700 of these discharges.

CHARLES CUTTRISS: I would like to ask Mr. Acheson in regard to these diagrams, as taken from the negative. You will observe in both of them that there is a full light circle and then a tail. Now, I would ask if that was so on the photograph, or was it not a gradual broadening up without any abrupt line between the bright part and the other? It would appear to me as that was at the final discharge a greater volume of light or a more intense passage of current just at that distance to photograph the true hole, and show it across the table.

MR. ACHESON: If I understand the gentleman correctly, he wants to know whether the outline of the aperture in the disk is clearly defined. It is. On the negatives it is clearly defined. I think that you are correct in assuming that the first discharge is greater than any succeeding one.

DR. ALLAN V. GARRATT: I should like to ask Mr. Acheson if the plates were all of one make.

MR. ACHESON: Yes, sir, and all number 26. They were developed practically until they would not develop any more as near as I could tell.

MR. GARRATT: I see no reason under these circumstances to suppose that the trail of light, which I think a photographer would not call a ghost, is not correct. I do not see any elements of error there. In regard to the speed of rotation, some of these are only half the length of the others. I do not know with what degree of regularity Mr. Acheson can revolve a sewing machine wheel, but I should suppose that he would be able to eliminate an error of 50 per cent.; that is, if he worked it as hard as he could, and if he was in equally vigorous condition during all of his experiments, I see no reason to suppose that a very considerable degree of error was introduced. I cannot help feeling, gentlemen, that this paper is something that will lead to a good deal of discussion and investigation.

MR. BIRDSALL: My suggestion in regard to the spot of lights, showing the entire circle of the hole and then fading away, is that the first spark of the continued series of sparks which formed the discharge might be the one which has the most energy in it in the form of light due to conditions of the air, such as burning the dust in between the poles, or anything like that, and then the succeeding ones might have as much energy in them, although not so much of that energy in the form of light, but more in the form of heat, or other forms of energy.

MR. SERRELL: I would like to ask Mr. Acheson which way his wheel turned around, whether the tail was due to the wheel gradually cutting off the light on the plate, and the spark being produced by duration, or whether the first bright spot was due to the first flash, and the wheel went in the direction of the tail.

MR. ACHESON: When you look at this sheet, assuming that the disk is between you and it the disk was revolving in a direction contrary to those poles, and by the photographic process they became reversed here; the aperture moved in the same direction in which the tail faded.

HOLBROOK CUSHMAN: I should like to ask Mr. Acheson whether the photographs through his moving disk were always photographed through a permanent diaphragm.

MR. ACHESON: It is the *A* spark that produced both; that is the *A* spark when it was formed, when it was alone. It produced both spots *A* and *B*. If the *A* and *B* sparks were together, they united and formed these two spots; but the *A* spark always assisted at least in forming both the *A* and *B* sparks. When the *B* spark was produced, it likewise formed a portion of each.

SECRETARY POPE: The next paper to be read before the institute in the regular series will be by Lieutenant F. Jarvis Patten, a member of the institute, on February 12th, entitled "A New System of Multiplex Telegraphy," with illustrations. It is possible that during the present month an extra paper will be presented by F. L. Pope on some recent work in the field of electro-metallurgy. He is engaged in the preparation of this paper now, but he is not certain about the time at his disposal, and it is barely possible that he may not have it in readiness, but if it should be ready due notice will be given as usual.

Chicago Electric Club.

[illegible] formal meeting of a few representatives of [illegible] upon M[illegible]

M[illegible] [illegible] eration of this club. It seems to me that the same principle that is followed by corporations when they invest in line materials should be followed by those who wish to control our methods of installation of plants. When the government, as we heard last Monday night, wished to install a plant upon a steamer certain rules [illegible] to be followed by those who proposed the installation, and had to be followed carefully. Now, it seems to me that some rule in which there is reason should be proposed to guide those who install plants. In [illegible] it seems to me we ought to have a general idea of what insulation is. The word insulator is probably improperly used. There is no such thing as an insulator. All materials might be classed as conductors, taking silver and annealed copper as the best conductors and coming [illegible] to gutta percha and paraffine and other special insulating compounds which are the poorest conductors or so-called insulators. The root word and the word insulation does not convey the right idea. It was thought a few years ago that there was such a thing as a non-conductor, but recently it has been proved that there is not; that all substances conduct to a certain degree, but after they reach a certain point they conduct so poorly that they are still known as insulators. Now, in dealing with insulators there is one thing that should be considered. That is, the way in which the current or the stress on the insulation takes place. To force a current through an insulator or poor conductor, the electromotive force or difference of potential would be applied upon the opposite sides of that insulator, as the current passing through follows Ohm's law exactly the same as though that insulator was replaced by a wire or a conductor. Thus it is that in the consideration of the formulæ that were offered by Prof. Badt one week ago, he follows each case by an example, showing the actual passage of current; showing how much current is conducted by this so-called insulator and reducing it to a percentage in such a way that we are enabled to see what percentage of leakage takes place. For illustration, take a piece of gutta percha one foot in area, 144 square inches, 1-1000 of an inch thick. It will offer a resistance to the passage of the current of a certain number of ohms. I believe, 1,066 ohms for the total area of one foot and for the thickness of 1-1000 of an inch. Now, if we divide that sheet up into strips which shall be twelve inches long and one inch wide, we shall increase the resistance twelve times, because we will have one-twelfth the area upon which the same stress of electromotive force is exerted. If you divide it again longitudinally and take one square inch we will have 144 times the resistance, following, as you see, exactly Ohm's law; that is, the area into the difference of potential. The insulating properties of course, will increase directly with the thickness of the sheet. For instance, with the sheet 2-1000 of an inch thick, the total resistance offered to the current would be equal to twice 1,066. If this sheet were cut up into strips, and this strip was the total length of the wire, which in the case of this formula is taken as one mile, then we should expect if the gutta percha was used, the resistance to be inversely as the length of the wire and directly as the thickness of the dielectric used. Inasmuch as all leakages tend to take place along the wire, from the earth to the wire, or from the wire to the earth, according to the respective height of potential of each, the insulating properties of the wire should be taken per unit length of the wire, because if it were not so, a ten mile length of wire, for instance, would have to have the same total insulation as a one mile length of wire which would make each mile ten times as great an insulation as the one mile with [illegible] greater stress per difference of potential. It is for that reason that the element L is used in Prof. Badt's second formula for arc light systems, where the resistance is equal to the electromotive force into N over L. For ten lamps, 50 volts each, one mile circuit, would require half a megohm. The second example, where we have ten lamps, [illegible] each, ten miles circuit, would require a total resistance of 50,000 ohms, or the same resistance per mile. [illegible] have a cable of a given total insulating resistance per mile, which is sufficient to stand any strain that it is to be [illegible] to—that is all that is required. If you attach another mile on the end of the first, you do not change the [illegible] the first mile at all, and therefore what is the reason that two miles taken collectively should have twice the resistance per mile that the first mile should have, just because you have attached another mile to the end [illegible] of the formula is very nicely shown in each [illegible] examples. It seems to me that the constant [illegible] changed, and that is one of the matters that we are to discuss to-night, the value of these constants. [illegible] element of length which I have urged from the [illegible] appears in that formula as it [illegible] class 3, as will be seen.

I think this idea of unit length is a very [illegible] owing to the fact that the whole insulation resistance is taken in multiple arc and taken as [illegible] And the area should be considered [illegible] formation of the formula. I think [illegible] tain the element of length as to what that length [illegible]

[illegible] alternating trans- [illegible] value than would [illegible] the electromotive force might change it somewhat. Leakage is the last point [illegible] formula it appears as if the total loss occurred at the extremities of the line where the full value of the electromotive force is felt. The value for that expression of loss should be an average taken at half the length of the line, or half of the total difference of potential of the system, for the reason that the weak place in the line is just as liable to occur out of a point midway in the expenditure of electromotive force as it is between the terminals, and very much more liable to occur, because the terminals are those points nearest the station, nearest the point of generation of electromotive force, and under the more constant supervision or under the more easy access of the expert at the station, and are generally kept in better shape than those out miles away from the station, where only the lamp trimmer sees them from time to time. The leakage, if taken for the total value of the electromotive force would be very much in excess of the leakage which would actually, in all probability, take place; and this leakage, of course, is the element by means of which the value of the constant is determined. Because if the leakage is a very large percentage of the total output, we must raise the constant to such a value that the total leakage will be provided for. If you take as the major premise of that reasoning, that the leakage takes place wholly at the point of greatest difference of potential of the line, then our conclusion, based upon such premise, must be wrong. And if the constant value of the formula is based upon such reasoning, then our formula should be changed so as to be applicable to the way which the leakage actually takes place in practice. The value given for the transformer system, for the multiple series system, I think might be varied somewhat, but those are matters which can be brought up for discussion, and I hope that others will take part.

Mr. Leonard: Mr. Chairman, when this matter first presented itself for my consideration, I endeavored to arrive at a formula that would be sufficiently comprehensive to cover in application all electrical plants and the requirements of all insulation. It became evident, and I think it probably is evident, to all present, that the insulation requirements would vary directly as the volts employed, but that there would be the same constant in that formula. As to the other factors composing the formula, of course the first thing that presented itself was naturally the insulation per unit of length, as all wires and cables made and insulated are measured in such a way, and guaranteed by the maker in such a way. A formula, which had in it as one of the factors the element of length, it struck me would be impracticable, because the authorities, who are endeavoring to secure the requirements of insulation, would very frequently have to rely on judgment altogether or the statements of those who had installed the plant. It is frequently almost impossible for the inspector to determine how many miles or how many feet of wire are installed in a certain building, and the statement of the contractor who installed the work would be the only thing which he would have, except a general approximation of the length, which very frequently would be widely incorrect. It was with this idea that I endeavored to secure another factor, which would be evident and easily determined. The current of the devices being well known, and the number of devices in the circuit being well known, the factor C, or current, could be positively arrived at, and there would be no chance for any dispute between the inspector and the party who had installed the plant as to the necessary requirement under the formula which had been adopted.

Of course there is no question that it is difficult, and perhaps impossible, to secure a formula which will be sufficiently comprehensive to be absolutely correct and just in all cases. But one thing impressed me forcibly, and that is, the necessity of securing but one formula. The action of electricity follows but one law, Ohm's law, in overcoming insulation, and it seems to me plain that we ought to be [illegible] formula which would include all ap- [illegible] whether the voltage is low or high, [illegible] in an electrical way may vary. [illegible] formulæ covering the vari- [illegible] and as the applications of electricity are rapidly increasing, the various systems modified, and as [illegible] which may involve ad- [illegible] it strikes me that we will very soon get [illegible] practical application of them will [illegible]

[illegible] I think, [illegible] long distances, [illegible] applications in the [illegible] a very high electro- [illegible] where the [illegible] important factor [illegible] be com- [illegible] electromotive force [illegible] have to [illegible] of the conductor [illegible] in ordi- [illegible]

that this was rather small, and suggests 25,000. If we have 25,000 for that formula in a very large application, 4,000 lamps in multiple arc or a two-wire system, the loss he gives, and no doubt it is correctly figured, is $\frac{1}{1000}$ of 1 per cent. But when he applies the various formulæ to the other cases, the arc system, for instance, and the lowest percentage of loss which he arrived at is $\frac{1}{100}$. In other words, in the case which would demand the highest insulation he gives the lowest loss, a loss that would be more than twice that which the requirements of the formulæ would impose upon the direct incandescent system. The factor V is fixed, and a good factor in the formula. Whether we can get some other factor besides C and L which will cover the case is a matter which is worthy of discussion, and I think of the two, in case we do stick to one formula, that the C would be the more readily determined and easier of application, and I do not see how, in the ordinary application of the formula, that would be doing any serious injustice to any company installing electrical plants.

Now, I have figured out briefly the requirements in several cases, which would be those met with. For instance, the smallest current and voltage which would probably be met with would be that of a tap line of an incandescent circuit, which would take about a hundred volts, and about five amperes. Now, in the formula which I had proposed this would give a requirement of 200,000 ohms' insulation resistance in the tap line. We can see from practical experience that that is a very fair figure, and one which can be arrived at for all cases, and yet one which cannot be very materially exceeded with justice to the contractor. In the case of the small incandescent light plant, one of the smallest made, having 100 volts and perhaps 20 amperes, the insulation requirement would figure 50,000 ohms. That can easily be attained, and yet also be a fair figure. In the case of a large incandescent plant on the two-wire system, such as the Auditorium building, the insulation requirement would figure 400 ohms for the entire system in multiple arc, and at the tap line, as before, 200,000 ohms. In an incandescent three-wire central station of small size, about 500 lamps, the insulation requirement would be 16,000 ohms. In a station such as the Chicago Edison company, having a capacity in its conductors for the operation of 40,000 lamps, with 220 volts, the insulation requirement would be 220 ohms for the entire system. In the case of an alternating system of 500 lights, with 2,000 volts, which gives the highest voltage at present in use generally, with one of the smallest sized machines, both facts of which would tend to make the insulation requirement the highest, the insulation requirement would be one 1,600,000 ohms. But I notice that Prof. Badt for a similar alternating system of 2,000 volts arrives at 4 megohms, so that his requirement would be much higher than ours in such cases. In the case of an arc circuit with 2,000 volts and 10 amperes, the insulation requirement would be two megohms.

Now, those points quoted cover nearly all the applications going to the extremes, and yet the requirements are easily to be arrived at by first-class work, and we have a very simple formula. At any rate it can be arrived at within a half per cent. The voltage can be determined accurately, and the only other element is the constant, which is absolute. If we adopt for a general practice a formula which has E and L as factors, it strikes me that while the insulation requirement as proposed by Prof. Badt for an arc light circuit would be satisfactory, that the application of his modification of my formula to a large incandescent plant would make the insulation requirement unnecessarily low, because the length in such a case as that becomes enormous. I should say that probably the length of a wire used in a building, such as the Rookery, per 16 candle lamp, would be about 100 feet; that is, the average distance to the lamps would be about 50 feet. Now then, if we apply the formula proposed for arc lights in such a case as that, we would have 100 times a 1,000, and in the case of the Rookery, where the wire for 3,000 incandescent lamps with 100 volts per lamp, we have 300,000 for the denominator, which would give us for our building one-third of an ohm. By my original formula we would have 100 times 10,000 divided by the current, which would be about 1,500. It would be about 600 ohms, which I consider fairer, and covering the case far better.

Mr. Sargent: I have not given this matter any great attention, but in our first meeting I thought the factor L should take the place of C; and I still think so, because I think it puts the formula on a truer basis. C, it seems to me, should be omitted entirely. Now, I will give you an instance where the use of C in the formula seems to me a little absurd. In the case of a building with a line going into it of 100 amperes, for a motor, and also a line for about twenty lights, one line being taken from a power circuit and the other from a light circuit, both of the same potential, less insulation would be required according to the formula with C in it for the line carrying the 100 amperes than the one carrying twenty lights. It would seem that the line that is carrying the larger amount of current should have better insulation if any difference than the one carrying the smaller current. It strikes me, after looking the matter over, that the second formula proposed by Prof. Badt, where E equals V times 1,000 divided by L, is suitable for almost all instances of both arc and incandescent work that I can think of. In an arc light system of 1,000 volts it would give an insulation of one megohm per mile, which I think is very fair and practical. I have also figured out several incandescent circuits in connection with the formula, and it takes me [illegible] within the keeping of good practice in every instance. In taking an extreme in [illegible] of the Chicago Edison company's [illegible] we have about 250 miles of cir- [illegible] of from 500 to 600 ohms [illegible] it would be also [illegible] to be kept up to that [illegible] the second formula of [illegible] practical for all [illegible] incandescent circuit. Of [illegible] for the inspector [illegible] incandescent work, and [illegible] hard to de-

termine. The inspector would have to depend upon information from outside parties, such as the contractors, for instance. I think if we could adopt the formula with the factor L in it, taking the place of C, as suggested, and have only one formula for all, both arc and incandescent, it would be just what we want.

Mr. Sperry: There is no doubt but that if one formula could be arrived at it would be far better than a multiplicity of formulæ. Now, the first remark that was made by the chairman was, that in all cases this insulation should be taken as per unit length. If then the insulation should be considered as meeting the resistance for a single unit of length, there is but very little difference between your formula and the second formula proposed by Mr. Badt. The L is for unit length any way, so that the formulæ are very similar. It resolves itself into formula number 1. When E is constant, no matter how much net work you have, no matter how large a system you have, it seems to me it would be easy to arrive at the element L in the incandescent system. Take the laws and rules followed by the British government in the specifications for their cable; it depends upon a table that would cover the side of a morning paper, but they use those tables, and a small table of constants for multiplying the number of lamps, the number of motors, or number of transmitting devices, whatever they may be, and they can easily be determined, and settle upon the value of L. In the arc light system the current is constant, and then the law is that there the current is constant, and E increases, and as E increases, generally the length of the circuit increases. I think that the point by Mr. Sargent is well taken, and that the second formula of Prof. Badt is one that is excellent in every way.

Mr. Leonard: It has just struck me that possibly you might combine these, and, if you attempt to apply it, perhaps you may find a solution of the thing in some such shape as that (E multiplied by 1,000,000, divided by C and L).

Mr. Thompson: Mr. Chairman, I was present at the last meeting and I have tried to see if there was not some way of getting those two factors together. That same constant that you speak of was the one that I found to fit the case exactly, and the formula was the same. It seems to cover all cases. Now, in going into it a little further, I put the formula in a slightly different shape by making two, one for arc lighting (high potential) $\frac{E\ K}{L}$, and one for incandescent lighting (low potential) $\frac{E\ K}{C}$. In incandescent work the fact that can be most readily determined is current, while in arc lighting the length of circuit can be easily and accurately arrived at. I agree with Mr. Leonard that estimating the length of wire in a large building would be a very difficult matter. The inspector might take measurements enough to get something near it, but he might be largely over or largely under. Whereas, in arc lighting the length of circuits can be much easier determined. I think that it would be better to have two formulæ, one for potentials of say 300 volts or less for incandescent work, and another for higher potentials, using it for arc work. I think that the point made that the wire carrying a large quantity of current should be better insulated than one carrying a small quantity, is not properly taken; for the insulation does not depend upon C, but on e. m. f. The higher your electromotive force the greater the effort of the electric current to disrupt the dielectric, no matter whether your wire has a cross section of 1-1000 of an inch or an inch. It seems to me that if one formula cannot be got to fit it that it would be better to have two. I think for incandescent work the constant K should have the value that Mr. Leonard has assigned it—10,000. For arc light work the value assigned it (1,000) by Prof. Badt seems to me to be very fair.

Mr. Leonard: I will call the attention of the meeting to one point. If you have one formula the percentage of loss, no matter by what system, will be the same; that is to say, the percentage of loss by formula, as originally proposed by me, would be one ten-thousandth of one per cent., and if you adopt such a formula as the second one I proposed—$\frac{V \times 1{,}000{,}000}{C \times L}$, L being in feet, not miles—it will give fair enough results, as regards the number of ohms to come within the requirements, and will be easily within the possibilities by fair work. It will make the percentage of loss in two plants, requiring entire high potential or low potential identical, and it seems to me that that is a desirable feature.

Mr. Cutter: Mr. Chairman, I must say that I agree with Mr. Leonard on the question of simplicity, but I go even further than Mr. Leonard, in so far as I do not want any formula at all. I do not like it in the algebraic shape or the mathematical shape, but, if necessary, we might offer a definite statement as to what the minimum resistance would be. Of course, we are trying, by adopting a formula, to cover the conditions of different lengths of circuits, and these formulæ are all made upon the supposition that the insulations were uniform. That is not the case in the majority of installations. It is the lack of uniformity that we must guard against. Now, for instance, when Mr. Leonard mentioned the installation in the Auditorium, I believe it was a total insulation resistance of 400 ohms. If that installation, measured as a whole, gave but 400 ohms, I should, for one, be a little suspicious of passing it, unless it was proved very conclusively that the insulation was uniform throughout that installation, thereby reducing it to 400 ohms. My experience has been that such would not be the case, that it is generally a few spots, and generally bad ones, that ought to be remedied, that brings down its insulation, and that the bulk of the installation is a great deal higher than we are called upon to-day to make it. The question before us is, if I understand it aright, to determine what minimum insulation resistance shall be allowed by law in the city of Chicago. I feel that the incandescent circuit of our central stations should be measured first at different localities, stores and houses, and everything of that sort by themselves, and then the street mains by them-

selves. For such installations decide upon two things for the private installation a minimum resistance, and make it the same for all of them, also the insulation per mile of the street work. I think that for most inside work 100,000 ohms minimum, as at present required by the inspector, is satisfactory, and before the certificate is furnished, the installation should be brought up to this standard. That is our minimum. Then have one megohm per mile for the main. The arc light circuits, I think, should be considered differently, because they cannot well be measured for each store. The minimum resistance of one megohm seems to cover the conditions very well, and I fail to see why it should be reduced, whether the circuit is two miles long or only a mile long. The electromotive force is generally higher in long circuits, and the leak is in bad spots, because the arc light circuits have few supports, and the insulation is not uniform; far from it, a long circuit ought to be well insulated. Even at a high standard they are dangerous to life, and the insulation ought to be at a high standard, not less than one megohm. Now, this is very important. It can be done. To refer once more to incandescent installations, bring these up to 100,000 ohms. It can be done. If it is decided that it cannot be done for over 1,000 lamps, then, say if we have a locality of over 1,000 lamps, measure every thousand lamps in the place, so that you know that the insulation is uniformly good.

Mr. Leonard: Mr. Chairman, Mr. Cutter spoke of the Auditorium, and of the fact that 400 ohms would be a low requirement. It was not the intention on my part in proposing my formula, with a plant of that size to be tested, that it be tested merely with one measurement for the entire plant. Each circuit should come up to the requirement of the formula, which would be 200,000 ohms. In the state that the city ordinance is in at present the requirement for the entire building would be 100,000 ohms, and it would be impossible, with the amount of wire there would be in a building of that character, to set as high a standard as that. Have every circuit tested according to the formula, and also the total plant tested according to the formula, which would be entirely safe, and cause no trouble in any way.

Mr. Wilmerding: I have been thinking of this thing in a little different light. I do not know whether I am right or not. It seems to me that the question of the amount of current that leaks out has something to do with it. Suppose we have an arc circuit of 2,500 volts. Now, the insulation, we will say, is ten times that. Now, we will suppose that a man's resistance is 5,000 ohms. In that case if the man came in contact with the bare circuit and grounded it, and the weakest point elsewhere on the circuit was 25,000 ohms, the total resistance in the shunt formed would be 30,000 ohms. If the resistance is 30,000 ohms, and the electromotive force in the circuit is 2,500 ohms, the amount of current that he would get would be .08 ampere, according to Ohm's law. I believe it is said that two-tenths of an ampere will kill a man. If we consider it in that way the insulation in this case would be sufficient and the shock a safe one. In wet weather our circuits get very low—as low perhaps as 10,000 ohms. When they are found to be as low as that, we always shut them off, though we do not start them so low. It seems that by multiplying electromotive force by ten, no matter whether it is a short or long circuit, you make the amount of current so small that it can not do any harm. In incandescent work it would be 1,000 ohms resistance on a 100-volt circuit, not considering the length. Of course, such a formula as that would be used as a minimum, and when a circuit got down to that point it should be shut down.

Mr. Sperry: I have been applying your last formula, in which there is the additional uncertain element of C, to some of our plants here in the city, and I find that in the case of the Merchants' Arc Light & Power company it would be required to maintain its line at 30,000,000 ohms; and the Arc Light & Power company would be required to maintain five-mile lines at 10,000,000 ohms. Now, the constant works very well in incandescent lighting. If you figure on the basis of length, as I said before, it is very easy to arrive at some multiplier for the length. Now, if we have an application for an arc light on a commercial line we know just about how much it is going to cost to put the light in for that man. We know that there is just about a certain length of wire required, and it will take about so much time for the linemen to do the work. We do not have to go in and measure them. We did at first, but we find that there is a certain multiplier that we can use, so that we know that it will cost about so many dollars to hang a lamp for a new customer. And in the same manner it will be very easy to find out how much line there was at the street and how many lamps on that line, multiplying the number of lamps by a certain constant it would give the amount of wire to be added, so that L is not so difficult a matter to determine after all. Now, as to the matter that Mr. Cutter spoke about, having a formula, I supposed that that matter was settled entirely. I think that a formula should be arrived at if possible.

Mr. Leonard: I think we all believe that everything that has been proposed has its point of weakness, and that every one of them, when applied, will bring results which may strike us as somewhat absurd when put to the extreme. I have not found as yet any application of the formula originally proposed by me which would not give an insulation sufficient, and an insulation which was feasible. When by an application of my formula to the case which Mr. Sargent spoke of, where a large motor circuit having the same voltage upon it, under the same conditions, as a few lamps would be required by the formula to have a much lower insulation than another line carrying a less current in the same building, it might strike us as rather absurd. I think that by any ordinary application of lights and motors in the same building that we can in the case of the lights come easily within the highest requirements of the formula, and that in the case of the largest motors the insulation derived by the formula will be sufficient for safe work. Now, the application of the formula with an L in it brings the incandescent lamps of large size entirely too low, and is more particularly applicable to arc lights. And it would not be [illegible] person, to [illegible] power [illegible] where we have [illegible] short length. [illegible] in such a case as that only two or three miles, in ca[illegible] very expensive [illegible] short length [illegible] very high electromotive force. [illegible] we can find a formula that will be entirely [illegible] way, but I do think that we can get one [illegible] although not [illegible] in every way [illegible] get sufficient insulation in the lowest [illegible] high insulation in the other extreme. [illegible] light circuit of 2,000 volts, if the current be twenty amperes, or if it be only ten amperes, the [illegible] being the same, and the [illegible] should be identical. In the formula proposed the requirement of twenty amperes would be one-half. Yet, I think, if we only get one-half of that derived in the case of the other extreme, the ten ampere circuit, that we would still be within the limits of safety, and in the case of the ten ampere circuit we could easily obtain the insulation required by the formula with first-class workmanship and materials. I think we ought to look upon this subject, not as one demanding a formula which is absolutely perfect, but if we can find a formula that, as I say, will give us safe insulation in the one extreme and an easily practicable insulation to obtain in the other extreme, that we will have accomplished a great deal, and the application of such a formula will lead to general satisfaction.

Mr. Whitmore: It seems to me that the trouble with the second formula is that it is too low as Mr. Leonard has applied it, in that he has used feet instead of miles as the denominator in the required plant. Suppose that we call 5,000 the length of one mile to make the calculation, and we have sixty miles for the length of the wire in the Rookery, it would make the insulation instead of one-third of an ohm 6,000 ohms. And I think if you take the length of the circuit in miles as the basis that we will find by applying this second formula that it is not too low in any case. Take, for instance, a central station of 4,000 lights on the three-wire system. It will give us 733 ohms, or nearly twice as much as Mr. Leonard's formula gives to the Auditorium with nearly 8,000 lights. If his formula is not too low, I cannot see where this formula is.

Mr. Leonard then worked out several examples, using Prof. Badt's formula, $R = \frac{E \times 1{,}000}{L}$, with the following result: 100 volts, 10 lamps, tap line one fraction of mile to be considered as one mile, R = 100,000; 100 volts, 3,000 lamps (building), R = 1,600 ohms; arc 2,000 volts, one mile, R = 2,000,000 ohms; alternating system, 2,000 volts, 1 mile, R = 2,000,000 ohms; Chicago Edison station, 220 volts, 300 miles, R = 726 ohms; power transmission, 2,000 volts, 3 miles, 666,000 ohms.

Mr. Leonard: Well, that seems to be pretty general in its application, within the reach of all, and to be of sufficient insulation.

Mr. Cutter: I want to ask Mr. Wilmerding if he can tell us the length of his different circuits.

Mr. Wilmerding: They vary up to five miles and a half.

Mr. Leonard: That would give perfectly safe insulation, from the lowest attainable insulation to the greatest.

Mr. Sperry: Of course, for self-protection, we have got to keep the line up at a high point of insulation. And it seems to me that that one formula is just about as perfect as it is possible to get a formula.

Mr. Thompson: Mr. Chairman, I think it would not be a very bad idea to have an informal vote on this subject just to see how we stand with regard to that formula.

Mr. Leonard: It seems to me that there will not be a sufficiently great error in any case than to more than double the requirement.

Mr. Cutter: Is it to be understood that each installation is to be tested as a whole regardless of the different branches of it?

Mr. Leonard: I should say of my own personal opinion, by no means. I should say that the least insulation would be that which would be demanded as proposed by Professor Badt, not to consider a length less than a mile in any case. In other words, with 100 volts the least insulation we could have and pass a plant would be 100,000 ohms for each circuit.

Mr. Sperry: Mr. Chairman, it seems to me that the former speaker confounds the idea of insulations and installations. Now, that this wire that we use is a good insulator or a poor insulator has nothing to do with the case. The wire needs to be supported by its numerous supports, and come out of the basement or the area way of the walk up inside and out on the lamp where the carbon in the various parts of the lamp are perfectly uninsulated and free to the atmosphere, and go through with the process, and that in the incandescent light, after going up through damp conduits and conducts, up through the brickwork and so on, the insulation that is measured, of installation, not insulation, the installation resistance must be at 100,000 or more. Now, the beauty of this formula, to my mind, is its simplicity, and the ease with which it may be operated by the inspector. All in the world he has got to do is to take each branch as a mile and measure his insulation up. Take the smallest incandescent plant, and it is the incandescent system that seems to give trouble in getting at the mileage; there is no trouble in getting the mileage of arc lights at all. Take the tap line and follow it, if you cannot do it any other way, and in the incandescent plant take the smallest plant and consider it a mile.

Mr. Cutter: Mr. Chairman, Mr. Sperry has expressed my sentiments exactly. Therefore, why do you need the formula? If you are going to divide your installation, not insulation but installation, into individual factors of one mile, more or less, state it one mile, and fix a minimum of 100,000 ohms, then you have covered your conditions and do away with your formula and all questions in relation to the application of that formula. It is easy work here to [illegible]

[illegible] being sufficient, say that for arc light circuits the [illegible] should be one megohm, and [illegible] groups [illegible] ohms.

Mr. Sperry: The fact is that if we should do that we would perpetrate the grossest injustice on the arc light people. Now, if we should say, as [illegible] insulation should be one megohm, every one who is engaged in arc lighting, who has extended [illegible] ground will find it impossible to keep these [illegible] such resistance. It cannot be done. But yet if that insulation resistance per mile is kept up, or anywhere near it, that plant is perfectly safe and is perfectly economi[cal in the long] run, so far as leakage of current is concerned, and, as I said, is safe to life and property. Therefore, I think that is a sufficient reason. I think that the formula should receive our hearty indorsement. I make a motion that we adopt this second formula of Professor Badt as one which we as a club can recommend for use by the municipality, and to the consideration of companies in electric lighting, and the transmission of electric energy.

Mr. Wilmerding: I would like to ask whether this insulation as it works out in the formula is supposed to be necessary to be kept up on the circuits, and if a circuit is found below the insulation that this formula calls for, it would be necessary to shut it off until the insulation is brought up to that point, or whether the idea is that you are allowed to work on the best way you can until it gets down so low that you have to shut it down. In this case if it is to be a formula that is of any use at all, of course it ought to govern the insulation of the circuit at all times.

The Chairman: I should say, if the motion be carried it will be an expression of opinion of this meeting as to the proper requirement of such a case as that, and carry with it a recommendation to undertake and accomplish that.

The chair put the question to the club, and it was carried with only two dissenting votes.

Mr. Thompson: Professor Badt in his formula specified some different thicknesses of dielectric. I think that is a question of some importance. It was very clearly brought out in the first meeting in which this was discussed [illegible] gave the minimum thickness that would be necessary. Mr. Haskins very clearly showed that although an insulator could be used that had very high resistance, still the dielectric could be disrupted with its strong current. In incandescent systems of not over 250 volts the thickness of the dielectric should be [illegible] of an inch. In arc light systems the dielectric should be $\frac{6}{32}$ of an inch. In alternating transformer systems, not over 2,500 volts, the thickness of the dielectric not less than [illegible] of an inch. I believe these are the figures that are required by several governments. I have seen wires tested that gave very high insulation resistance, particularly where gutta percha or some of its compounds were used, and yet the dielectric was very thin. I know that in all government work particularly the thickness of the dielectric is always insisted upon, and I believe that the Phœnix Fire Office rules require it, as [illegible] the German government. Professor Badt did not tell where he got the figures from, but I know that $\frac{3}{32}$ of an inch on all incandescent work is required on marine work, with which I am best acquainted.

After requesting Mr. Thompson to prepare a paper on the subject of dielectric the club adjourned to January 21st, the date of the regular meeting, for the further [illegible] of the topic of insulation.

CORRESPONDENCE.

New York Notes.

New York, Jan. [illegible] A meeting of the [illegible] Electrical Control is called for Friday next, at the mayor's office. There is no doubt that the [illegible] by the mayor to the board seriously impeded its [illegible] at a time when all the support available was [illegible] with a mayor pledged to put the wires underground the board will be materially strengthened, and its meeting on Friday will probably be the [illegible] activity. The fact that it is the intention of the mayor to hold the future meetings of the board at his office, may in itself be taken as [illegible] position to cooperate with the board [illegible] this [illegible]

In the [illegible] own electric light plant [illegible] electric light station [illegible]

[illegible] in the [illegible], when [illegible]. The mayor of [illegible] inspection along the circuits, and celebrated the event with a bounteous [illegible] in Massachusetts [illegible] appropriation of $4,- [illegible] is recently made to defray the expenses of running [illegible] the station is commodious and the electrical and steam plant equipments are first class [illegible]

The New York clubs are affording abundant evidence of their appreciation of the advantages of the electric light. The Tucker Electrical Construction company has lately secured the contract for all the work in the Central Turnverein building, Sixty-seventh street and Third avenue, and also for the Progress club, at Sixty-third street and Fifth avenue. The Excelsior Electric company has installed a fine incandescent plant at the Freundschaft club, Seventy-second street and Park avenue. If one can judge by the complete and luxurious form which electric lighting here assumes [illegible] developments of its artistic capabilities may be looked for in the near future. In sub-basement are two 500 light dynamos, and a 125 straight-line engine. The current is controlled by automatic regulators, and sparking is prevented by the use of improved switches. The arrangement of the lights is admirable. The second story constitutes an immense dining room which will seat 800 people, and here the chandeliers are handsome pendants with globes at the bottom, surrounded by festoons of 16 candle power lamps. The third floor is a ballroom. Rays of light radiate from the center of the lavishly ornamented ceiling, and an immense glass ball is filled with incandescent lamps, and shines out with brilliant effect. At other points in the ceiling stars of incandescent lamps are let in. The rest of the lighting is on the same scale, and the whole of the arrangements afford another illustration of the rapid strides that are being taken in this, as in many other applications of electricity.

It may be of interest to note that the Edison Illuminating company has erected in this city two of the finest electric lighting stations in the world. The light will be sold to consumers through the Edison meter. The area proposed to be covered is bounded by Seventeenth and Fifty-ninth streets, and Third and Eighth avenues, and the distribution of current over this vast area is accomplished by the 3-wire system. The conductors, which consist of the well-known Edison electric tubing, have a current-carrying capacity sufficient to permit connecting 200,000 16 candle power lamps. The power of the station consists of fourteen 2,000 horse power Armington & Sims engines, 18½ inch cylinder, 18 inch stroke, and making 200 revolutions. There are two driving wheels, each of which is 86 inches in diameter by 16 inches face. The weight of each wheel is not less than 4,500 pounds. There are twenty-eight dynamos, each of which has a capacity of 600 amperes, and an initial e. m. f. of 140 volts. They weigh 15,000 pounds each. The speed of the armature is 650 revolutions per minute. Two dynamos are driven by each engine. The boiler floor has on each side a large battery of Babcock & Wilcox water tube boiler, each battery having a capacity of 1,400 horse power. A supply of current can be made available for maintaining at proper incandescence 35,000 16 candle power lamps, for any consecutive number of hours [illegible]. This will supply at least [illegible] lamps connected to the mains of the underground system. [illegible] of the three stations, for a third and [illegible] is in course of construction [illegible] candle power lamps at one time, which will permit of, at least, 250,000 lamps connected to [illegible]. Although these stations [illegible] lamps, as [illegible] ample re- [illegible] of these [illegible] 25 per cent [illegible] and with such a call not a single [illegible]

[illegible]

English committee to get at bottom facts. The English committee will also look into the financial affairs of the company, and a list of the assets is being prepared. [illegible]

St Louis, Mo.

St. Louis, Mo., Jan. 19.—Fielding Mansfield, president of the Telephone Subscribers' Protective association, has issued an address to the members, in which, after reviewing the history of the telephone controversy in the city, he says: "On the day of the publication of the Supreme court decision public statement was made that a bill fixing the charge for telephone service would be introduced in the legislature on the first day of its session. Several bills of this character have been so introduced. Since January 1st the Telephone company has demanded the signing of contracts at the old rates for the period of one year, in order to exact, by virtue of these contracts, the $100 rate for one year, although a less rate may be fixed by the legislature. In all fairness this company should have inserted in these contracts a provision which would make the annual rate of $100 void in the event of a passage of a bill fixing the rate at a sum less than that named in the contracts, or the contracts should have been made for a period of three months, and so renewed until the matter is determined by the legislature."

The Telephone Subscribers' association has five canvassers at work soliciting signatures to the petition for an act regulating telephones, to be submitted to the legislature. The proposed bill provides that no telephone company shall charge for rental over $4 per month in cities having a population of 100,000, and in towns of less than 100,000 not more than $3 per month. Any person who charges more than these rates shall be deemed guilty of a misdemeanor. Any city having over 100,000 inhabitants shall be empowered to order companies to bury their wires.

Manager Durant says: "The child is not born who will see telephones rented in this city for $4 per month. But even should the bill be passed I do not see how there can be any retroaction, so far as the contracts are concerned. They will stand. We are renewing our contracts right at the old figures. I cannot tell what the company will do if the bill passes."

The St. Louis railroad (Broadway line) tested its new electric system with much success last week. The power used is derived from a central house and is distributed on wire overhead. The route of the electric road is on Broadway from Wyoming street south to Keokuk street. The distance is nearly a mile. A car was put on last week and to it was attached a regular passenger coach, and the train made seven round trips. The cars ran smoothly, and without accident. It is possible under the overhead wire system, it is claimed by the management of the road, to make twenty miles an hour, but, owing to the city law regulating the speed of railways, the experimenters were not permitted to test the new motor to its fullest capacity. The managers of the road are well satisfied with the result of last week's experiment, and promise to put on two more trains.

The board of public improvements met last week for acting upon the recently adopted ordinance, whereby the city is to be lighted by electricity during the ten years after the year 1890. The committee, consisting of President of the board Flad, and Commissioners McMath and Holman, reported a form of advertisement.

The house of delegates' special committee on the disposition of electric wires within the city limits gave several hours last week to the consideration of the question. A little was said about high poles and President Flad's proposed tower system, but most of the time was given up to the consideration of underground conduits, with the Dorsett conduit bill as a basis of discussion.

A stock company with a capital of $50,000 has been organized to construct and operate an electric railway from the junction of the new and the old Manchester road to the city limits at Benton station. All the stock has been subscribed. The council committee on railroads held a session last week to hear arguments on the Broadway and Seventh Street Elevated Electric railway bill. An army of objectors [illegible] to show why the committee should not recommend the bill for passage. Owing to the brief session only a few could be heard on the subject. The committee [illegible] to hold two more meetings [illegible]

[illegible] president of the Bell [illegible] concerning the pro- [illegible] a motive power [illegible] meeting [illegible] However [illegible] we [illegible] immediately. We [illegible] although [illegible]

the cost would be about $200,000 to the company. We cannot reduce the number of cars, as our patronage will not allow it, so you see this change will nearly double our running force. We figure, however, on shortening the running time to twenty-five minutes for the trip from the water tower to Third and Washington avenue. We feel quite confident that the overhead wire system is the coming one and just as soon as we have assurance that we will be allowed to put up the wires, the changes will be made."

J.

St. Louis, Mo., Jan. 21.—The special committee appointed by the municipal assembly to investigate the proposed systems of carrying telegraph, telephone and electric wires reported unanimously Friday evening in favor of the underground conduit system. Experts from Chicago, New York and St. Paul were heard. The committee recommended the adoption of the Dorsett system and the passage of the bill now before the assembly granting a franchise for a subway. A bill will also be introduced to abolish aerial wires and poles. The Dorsett bill is expected to be passed to-morrow. McD.

Kansas City, Mo.

Kansas City, Mo., Jan. 19.—The aldermen put in much time at the last meeting talking over a resolution asking the legislature to lower telephone rates. The matter came up on a report from the special telephone committee, which reviewed some of the alleged inequalities which were spoken of in its first report a week ago, and recommended the adoption of a resolution to petition "the legislature to pass such laws as will compel the telephone companies to furnish service at uniform, reasonable and equitable rates." Alderman Phelps opposed the resolution, saying that, as a private citizen, he might favor such a petition to the legislature, but he believed it improper for the council to take such a step. Alderman Finley said it was his belief that the home company was forced to make high rates on account of the exorbitant royalties it had to pay, but he believed that a reduction by legislation would cause the holders of the patents to reduce their demands. After remarks by Aldermen Lee and Faxon the resolution was adopted.

The officers of the telephone company were much surprised when they learned of the council's action in joining in the request to the legislature for a reduction of rates. President Mulvane came down from Topeka, and during the afternoon a letter was sent to President L. E. Erwin of the Commercial club, asking the appointment of a committee from the club to go over the company's books. President Mulvane said that, inasmuch as such radical steps had been taken, the company had concluded to throw open its books for an investigation by any committee of reputable business men. "There is only one conclusion that such a committee can reach," said Mr. Mulvane, "and that is that the charges here are reasonable, and that the company's profits are very moderate."

General Manager W. W. Smith was much vexed by the council's action, and said that he regarded it as very hasty on the part of the aldermen to join in the complaint, inasmuch as the entire fire alarm service and the telephones in all the city offices were furnished free. He stated that if it was in his power he would feel very much like discontinuing the free fire alarm service, but a moment later changed his assertion, saying that he probably would not make such a rash move when he considered the number of people it would affect.

The telephone company is circulating a counter-petition among its subscribers, especially the business men, and Superintendent Smith said that a gratifying number of signatures were being obtained. The petition sets forth that the charges and service are satisfactory, and it will be forwarded to the legislature as soon as it is completed.

The committee appointed by the Commercial club, in response to the telephone company's request, met the officials of the company, and was given every opportunity for pursuing the work in hand. Books, vouchers, etc., were placed at the disposal of the committee, and considerable progress was made. The session was prolonged two hours during which time the receipts and expenditures for December were gone over, even to the most minute detail. The committee made a request for further facts and figures pertaining to the company's business which the officials promised to furnish at the earliest possible moment. The committee then adjourned with the understanding that they will report at the regular meeting at the Commercial club next Tuesday night.

The Kansas City Telephone [illegible] forwarded to Jackson county's representatives in the legislature the petition which has been numerously signed, asking the general assembly to pass a bill regulating telephone rates in all cities in Missouri having a population of 100,000 or more people. The bill that the legislature will be asked to pass

has been prepared, and is formulated after a similar [illegible] recently enacted in Indiana. It provides that no company operating telephone lines within this state shall receive as rental for the use of such telephones a sum exceeding $[illegible] per month in cities of 100,000 or more inhabitants, and in cities of less than 100,000 not to exceed $3 per month [illegible] be charged. It further provides that in cities of [illegible] or more inhabitants telephone companies may be required by ordinance to lay all the wires underground.

It is now a pretty well-settled fact that the $200,000 worth of stock necessary to make Kansas City the [illegible] quarters of the Missouri Phonograph company [illegible] easily placed among local capitalists. St. Louis capitalists stand ready to take the entire amount of the stock, $500,000, but Kansas City does not propose that they shall have it. S. P. Griffith is at the head of the company, and is confident of its success. R.

Pittsburgh, Pa

PITTSBURGH, Pa., Jan. 20.—The Westinghouse Electric company has just finished the contract of lighting the Hoosac tunnel with incandescent lamps. The company frequently attempted to illuminate the tunnel with oil, gasoline and gas, but dampness invariably caused the lights to go out, and the tunnel was more or less in Egyptian darkness all the year around. The contract was then offered to several electric light companies, but none of them desired to accept it. It was argued that the damp atmosphere pervading the tunnel and the water from walls and roof would ground the circuits so that not a light would be of use. Mr. Westinghouse was convinced that the task of illuminating the tunnel could be accomplished. Contracts were at once drawn. The difficulty of working in the darkness of the tunnel, where torches shed a meager and uncertain light a distance of a few feet only, can be imagined. With smoke and constant dripping of water from the roof and sides, the laying of forty miles of lead-covered cables in a wooden conduit in a ditch on either side of the track, was an undertaking requiring extreme care. Trouble was also added by the incessant passing trains, by sulphurous gases from engines, corroding all the metal parts from the excessive moisture, and rendering imperative absolutely perfect insulation over 8,000 feet of distance. The undertaking was commenced twelve months ago last November, and completed two weeks ago. On January 1st the machinery was started on a thirty days' trial, one of the conditions of the contract, and if the trial is successful the plant will be given over to the railroad company.

The machinery consists of two 125 horse power boilers, a 125 horse power engine, three number 1 Westinghouse alternating current dynamos, each with a capacity of 650 sixteen candle power lights, and two direct current machines for exciting the larger dynamos. This provides for an extra machine in case of accident to either of the others. In case of a break any section may be cut out without interfering with the rest of the system. Each lamp is provided with a choke-off coil case, and if one burns out the other lamps in the section are not affected. The lamps are placed 40 feet apart on both sides of the tunnel, alternating and making one lamp to every 20 feet. Blue lights mark the manholes or places of safety cut in the sides of the tunnel. The Fitchburg Railroad company had several objects in view when going to the immense expense of lighting the tunnel. There was first the additional safety to the traveling public and workmen. Then there will also be great saving of time. Formerly trains had to pass through the tunnel, one at a time, and at a very slow speed. It has been calculated that in the way of speed the trains will save at least thirty minutes in their passage through the tunnel. The trial has now been going on for twenty days, and from a letter which was received at the Marr Construction company yesterday the WESTERN ELECTRICIAN correspondent was informed that not a single blow out has occurred since the first day of the trial. This alone is an unmistakable evidence of the fact that the plant is a success. H.

THE ELECTRIC LIGHT.

Clinton, Ia., is now lighted by electricity.

The city council of Slater, Mo., has authorized the operation of an electric light plant of sixty arc lights.

The Pueblo (Col.) Electric Light, Heat & Power company has voted to double the capacity of its plant machinery.

The Western Electric company of Chicago has sold a 30 light arc plant to the J. C. Melvin & Hammond Packing company, Hammond, Ind.

The Electrical Accumulator and Lighting company of St. Louis has been awarded the contract to furnish storage batteries to illuminate Dyersburg, Tenn.

J. M. Klinglesmith, the representative of the Thomson-Houston Electric company of Boston, has nearly perfected arrangements to supply Tuscumbia, Ala., with electric lights. Nearly all of the requisite amount of stock has been subscribed by the citizens, and they are sanguine of [illegible] ment of the work. [illegible] and the residences of [illegible] business houses.

H. W[illegible] residence at [illegible] incandescent [illegible] on the North [illegible]

[illegible] adopted at a public meeting [illegible] petition the legislature [illegible] for the purpose of [illegible] for $20,000 to [illegible]

[illegible] Baltimore pays $1.2[illegible] per [illegible] individuals. The gas [illegible] while the [illegible] icy, however, is having the effect of awakening the public to [illegible] of this course.

[illegible] being made in the [illegible] electric light plant and [illegible] Longmont, Cal. The stone walls of the basement are up, [illegible] which surmount it [illegible] will be completed early next week.

American boy—"Papa, the paper says that Japanese war vessels are illuminated by electric lights. Why don't the United States have things that way?" Papa—"We have made a beginning in that direction, my son. We've got the lights."—*Philadelphia Record.*

The French Edison company will supply six dynamos for the Paris municipal electric light station, and three Ferranti dynamos will also be used. The Edison machines are capable of an output of 400 amperes each, at 110 volts, while the Ferranti machines have a capacity of 113 kilowatts.

A proposition was submitted to the city council of Baton Rouge, La., last week from J. H. Andrews, representing the Van Depoele company of Chicago, to light the city with twenty arc lights of 2,000 candle power each for the sum of $1,800 per year, to be paid by the city for three years, additional lights to be furnished at $85 per year each. The proposition was accepted by the council, and the mayor and city attorney were authorized to draw up and sign the contract. The plant is to be in operation by March 16th next.

Among the recent sales of the Thomson-Houston company are the following: Cleveland, O., Rubber company, 400 incandescent lamps; St. Louis, Mo., 20 lamp arc plant for use in waterworks; Reno, Nev., Electric Light company, 600 lamps alternating system; Armour & Co., Pewaukee, Wis., 20 arc lamps for ice house; Badger Illuminating company, Milwaukee, Wis., 50 arc lamps, increase; Chicago, Ill., Sash, Door & Blind company, 150 lights, incandescent, for use in factory on Monroe street; Citizens' Electric Light company, Wichita, Kan., 1,300 lights, alternating system.

The Roaring Fork Electric Light & Power company has succeeded in demonstrating the practicability of operating an electric mining hoist at the Aspen Mining & Smelting company's works. The company recently erected a new brick building, 50x60 feet, which will enable it to extend its plant, which now consists of two Brush arc light dynamos, with a capacity of sixty-five lights each; two Brush incandescent light dynamos of 450 lights capacity each; one Edison generator for power of sixty horse-power capacity; and one Westinghouse incandescent light machine with a capacity of 650 lights.

THE ELECTRIC MOTOR.

The Cincinnati, O., Street Railway company, of which John Kilgour is president, has awarded a contract to the Thomson-Houston company to introduce an electric railway system. The contract calls for five miles of road and eight cars, and work will be begun immediately. As soon as this is completed, it is expected the work of extension will be begun.

Commenting upon the great development in the use of electrical energy the New York *Times* recently said: The fact that there has been an increase of overhead wires in this city during the past year in spite of the fact that provision has been made for 4,500 miles of underground conductors is mainly due to the rapid development of the use of electric wires upon lines where no subways have yet been laid, and to the delay in getting those fully occupied which have been completed.

The *Morning Review*, published at Spokane Falls, Washington Territory, says: The motive power for the *Review* presses is furnished by a three horse power Eickemeyer electric motor. This little machine is incased in a cast-iron box about fourteen inches square, and with belt pulley does not occupy a space larger than an ordinary grip sack. The boiler and engine formerly in use have been relegated to "innocuous desuetude." The *Review* will now be run off with lightning speed—necessary to keep up with the times, and the large increase in circulation.

The McGavock & Mt. Vernon Street Railway, of Nashville Tenn., which the Thomson-Houston company will equip with electric motors, is over three miles in length. There are seven curves on the line and numerous grades, the maximum being 5½%. There will be six cars each 16 feet in length, and capable of carrying 75 passengers, and equipped with two horse power Thomson-Houston motors. The overhead system will be used. This contract was not entered into until all the systems now in operation in the United States had been investigated. Electricity will not be used on the entire line at present, but a loop from Cherry street around by the Public square, back to the stables. The time consumed by a car making this trip is 70 minutes. The new cars will make this trip in 35 minutes. The consideration of saving one-half of the time is [illegible] animal [illegible] will, in [illegible] H[illegible]

[illegible] street railway [illegible] teen hours, and, accor[illegible] of the U. S. Signal Service officer statio[illegible] registered even fifty miles an hour. Every syst[illegible] able damage, and the service of the companies owning these wires had to be suspended for some time. The [illegible] with which they had been erected, and their stability, remained intact; nor did the terrific storm interrupt the [illegible] vice of the Sprague cars in the least degree. Followin[illegible] storm, upon the 11th of January, fell a very dense, fleecy, wet snow for several hours, which covered the tracks of the street railway to the depth of ten inches to a foot. The first car over the line carried a small supply of salt, which was distributed over the track, and after this was done no trouble whatever was experienced. All the morning and throughout the storm the cars on the [illegible] running [illegible] time, but no car on the electric road was behind time. Throughout the greater part of the day, while the storm continued, the cars did double duty by drawing a second car [illegible]. President Everett has [illegible] many congratulations in regard to his electrical equipment. It is said that the management of the East Cleveland Railway company intends to extend its line before long, using the electric system.

THE TELEPHONE.

The Italian Minister of War has made a series of successful experiments with a small portable magnetic telephone, submitted by Signor Nigra, over a distance of twenty miles.

A. K. Bennett contributes an article to [illegible] the question of adopting a name for a telephone message. He suggests "telephrase." Many other terms have been suggested, but none have come into general use. An effort was made several years ago to secure the adoption of the term "telelogue," but without success.

The electric wires came in contact with the telephone wires at Shreveport, La., recently, and [illegible] panic in the neighborhood of the telephone exchange. The young man who went to the instruments to learn the cause of the ringing of the bells made an effort to stop the ringing and received a severe shock. About fifty connections were burned out.

The messages transmitted over the United Company's wires, London, on a single day amounted to [illegible], while the messages for one week aggregated 586 294, being at the rate of thirty millions of messages per annum. The company is erecting a main trunk route to the north, and have already built half the trunk that is required to connect London with Birmingham. A main trunk to the west is also being surveyed with a view of placing Bristol and the South Wales coal fields in telephonic communication with the metropolis, while a new route to the south is in progress for the benefit of Brighton and the [illegible] southern coast. As these routes are gradually [illegible], outlying towns can be joined up to them, and thus establish a complete network of telephonic wires between the provincial towns and London.

THE TELEGRAPH.

A dispatch from Boston says: [illegible] Chester [illegible] this afternoon [illegible] the [illegible] $[illegible]. The [illegible] and the [illegible] Snow. The case [illegible].

Concerning the [illegible] that the Western Union [illegible] company was about to supplant the Morse system [illegible] Wheatstone plan [illegible]. The company has been using the Wheatstone system [illegible] time, but only for long distances [illegible] where the business has reached [illegible] old Morse system has been found [illegible] the work with expedition and [illegible]. The Wheatstone system will [illegible] ten times as many words as the Morse in the same length of time, with the [illegible] vantage of being [illegible]. It [illegible] the Wheatstone [illegible] telegraphic [illegible] as there [illegible] small amount of business [illegible]

volume. The supposition, though, that the supplanting of the old system would throw out of work about one-third of the 20,000 operators at present employed by the Western Union Telegraph company, is entirely erroneous. Such an increase of business would result that the present operators would be assigned to the branch offices in the country, where a proportionate increase would take place by reason of the introduction.'

G. B. Pierce, a telegraph operator, was held to the [illegible] H. White, in Chicago, last week, on a charge of obtaining money under false pretenses. Pierce is at present under indictment, and is out on bail for the same offence, together with three others who were conducting an alleged bogus telegraph school. The complainant in this case is Henry Webuhr, who paid Pierce $50 for a scholarship certificate.

An important action is pending in the United States Circuit court between the state of Massachusetts and the Western Union Telegraph company. The company was formerly assessed about $15,000 per year for taxes in Massachusetts, but in 1886 the state officials decided to raise this amount. The difference between the old and new assessments is about $15,000 per year. The Western Union company will fight the case, as defeat means similar proceedings in [illegible] states.

A telegram from the City of Mexico says: The Mexican Telegraph company, [illegible] business in this city, has arranged for the laying of a new cable across the gulf. The Texas office of this company was originally located at Brownsville, but some six or seven years ago was removed to Galveston on account of superior facilities offered for the handling of the business. They operate in conjunction with the South American Telegraph company, which has a line across the Isthmus of Tehuantepec, and their South American business has of late become so extensive as to render it impossible to handle both this and the Mexican business upon the present Mexican cable line. Hence the laying of this new cable, which will be used for the South American traffic, the present cable to be devoted exclusively to the handling of the Mexican business. The new cable will be completed to Galveston about February 10. The new cable will be 1,000 miles in length. The cable wire to be used weighs about three tons to the mile, hence a vessel of large tonnage capacity has been employed for the service—the steamship "Faraday," a vessel originally constructed for cable-laying purposes. This vessel laid the two French Atlantic cables, the cable for the United States Cable company, and the two Gould cables. She is a vessel of about 8,000 tons burden, and left Liverpool December 28th for her new field of operations. The size of the "Faraday" will not permit her to come close to the city on the gulf side, where the cable line will end, but she is supplied with a steam yacht for light draft coasting purposes.

Miscellaneous Notes.

A commission is taking testimony at Lockport, N. Y., in the legal controversy between the Cowles Electric Smelting company of Lockport, N. Y., and Camille A. Faure, who claims to have patented the system of electric smelting years before Cowles began his experiments.

Leonard & Izard, Chicago, have completed the electrical equipment of the Alliance, O., railway, which the Thomson-Houston company is installing. They have also completed the electrical equipment of the Sprague road at St. Joseph, Mo. The work on the Topeka road has been nearly finished.

The United States Illuminating company on its failure to secure an [illegible] against the Board of Electrical Control of New York, began an action for $200,000 against its members for damages alleged to have been sustained by the company through the action of the board in tearing down and destroying its poles and wires.

A dispatch from New York says: "The voice of Gladstone was heard in the Edison laboratory at Orange yesterday, and it was as clear and distinct as if he had been [illegible] Mr. Edison from one of the wonderful talking machines which he has invented. Mr. Glad-[illegible] taked into the [illegible] of Col. Gouraud, Mr. Edison's [illegible] 18th, and the cylin-[illegible]try. When the little machine [illegible] was heard, introducing [illegible] There was a moment's [illegible] came the following [illegible] I am profoundly [illegible] only, but the [illegible] most remarkable [illegible] Your [illegible] important work of [illegible] good [illegible]

Personal Paragraphs.

[illegible]

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of Salt Lake City, were registered at the Chicago Electric club last week.

S. Dana Green, assistant electrician of the Sprague Electric Railway company of New York, was in Chicago last week.

F. N. Armour of Chicago left for New York Tuesday evening to attend the formal opening, Thursday last, of the new quarters of the C. & C. Motor company, of which he is the western agent.

Business Mention.

Fred H. Whipple, electrical engineer of Detroit, has opened an office at 44 Broadway, New York. Philip K. Stern will be the Eastern representative.

The business of the Pond Engineering company of St. Louis has increased to such an extent that the opening of a branch office in Omaha was imperatively demanded.

The Western Engineering company has decided to remove from Lincoln, Neb., to Kearney, where it recently established an electric light plant for the city. The capital stock of the company has been increased to $100,000.

There has been considerable controversy in electrical circles in regard to the "Red Core" advertisement, which has appeared in the papers. While later advertisements indicate the fact that "Red Core" is an insulated wire, yet there is still a doubt as to who the makers are.

The National Carbon company of Cleveland, O., is sending to electric light companies and to those who apply for it an unusually handsome and useful calendar for 1889. On the face of the calendar is the lighting schedule for 1889, and on the reverse side of the leaf is the moonlight schedule. The schedules arranged in this form can be easily referred to.

The catalogue of the E. P. Gleason Manufacturing company of New York for 1889 is very tasty, and contains much valuable information regarding electrical appliances in brass, iron, tin and glass; embracing fittings, brackets, fixtures, shades, globes, insulating joints, cut-outs, holders, and supplies for arc and incandescent lighting Electrical people will find this company's catalogue E interesting.

The *Safety Valve* appears in a new and improved form. In the prospectus for 1889 the following statement is made: "Practically no departure will be made from the policy pursued in the past by the proprietors of the paper, but in some respects its work will be broadened, and, if possible, the scope of its utility widened, so that its objects may be more closely allied with the progress and welfare of the intelligent body of readers in whose interests it is published."

A pamphlet has just been issued in relation to the M. D. C. Ventilation System. The headquarters of the owner of the patents are at 21 and 23 Center street, New York. The pamphlet says: "At the outset, in introducing the M. D. C. Ventilating System, we wish to emphasize the fact that neither time, pains or expense has been spared in conducting investigations, research and experiments, to insure the good results obtainable by it, and that already the evidences of popular approval are gratifying."

Electrical Patents.

Issued January 15, 1889.

396,086. Synchronizing Device for Dynamo-Electric Machines. Carl Hoffmann, Berlin, Germany.

"Claim 4. In an automatic coupler for alternate electric generators, the combination, with a main circuit and an auxiliary alternate generator, of a magnet provided with an armature adapted to include the said generator in the main circuit at the moment their impulses coincide."

396,121. Thermo-Magnetic Motor. Nikola Tesla, Smiljan, Lika, Austria-Hungary.

396,124. Suspended Switch for Electric Railways. Clark H. Wells, Kansas City, Mo.

The last claim follows: "In an overhead system for electric railways provided with trolleys and depending motor connections, the combination, with a main conductor, of a branch and a swinging hanger supporting the free end of the branch and normally holding it in contact with said main conductor, and a gravitating obliquely-hinged guide arm attached to the free end of said branch and projecting into the path of the movement of a trolley advancing along the main conductor."

396,149. Unipolar Dynamo Electric Machinery. Rudolf Eickemeyer, Yonkers, N. Y.

Claims 1 and 5 are appended: "In an electromagnetic or magneto electric machine, the combination of a rotating armature provided with a series of independent radial bar conductors, and outside conductors which couple the outer and inner ends of the armature bar conductors and couple said conductors in linear circuit

"In an electro-magnetic or magneto-electric machine, the combination of an armature provided with a series of independent radial conductors and a series of conducting rings coupled in pairs to two or more of said armature conductors, and a series of outside conductors, communicating with said rings, and affording a continuous circuit which embraces at all points in its path two or more radial conductors."

[illegible] Electric Coupling for Hose Pipes. David [illegible]

[illegible] for Dynamo Electric Machines. [illegible]

[illegible] Support for Electric Conductor. [illegible]

396,199. Electric Appliance for Discharging Guns. Bradley A. Fiske, U. S. Navy.

396,207 Electric Signaling Apparatus. William Henion, Ritchey, Ill.

396,212. Electrical Body-Wear. John V. Long, Jersey City, N. J.

396,213. Secondary Battery. Orazio Lugo, New York, N. Y.

"Claim 1. The described process of preparing spongy or divided material for use in secondary or polarization batteries, which consists of mixing two metallic salts, then putting them in solution, and finally subjecting zinc to the action of this solution."

396,214. Secondary Battery. Orazio Lugo, New York, N. Y.

The first and last claims are given: "The described gas absorbent for use in storage or polarization batteries, consisting of superposed allotropic materials.

"A secondary or polarization battery having electrodes composed of atom-like material packed around conducting plates or surfaces contained in porous jars, said jars being immersed in an electrolytic fluid."

396,269 Electro-Dynamic Machine. Carl Coerper, Cologne, Prussia.

396,270. Process of Electric Welding. Charles L. Coffin, Detroit, Mich.

The invention is defined as consisting in forming a voltaic arc between two conductors extending outward from the conductors and submitting the joint to be welded to the action of the arc.

396,310. Travelers for Electric Railways. Charles J. Van Depoele, Chicago, Ill.

396,311. Hooked Suspender for Electric Railway Conductors. Charles J. Van Depoele, Lynn, Mass.

396,312. Suspension Device for Electric Railway Conductors. Charles J. Van Depoele, Lynn, Mass.

The fourth claim follows: "A device for suspending electric conductors, consisting of an arch secured to a transverse support or supports, an ear depending therefrom supporting the electric conductor, said ear having a horizontal flange formed at or near the upper part upon which the arch is adapted to rest, and a bolt passed through said flange and arch, whereby the same is rendered double."

396,313, Adjustable Crossing and Switch for Overhead Conductors. Charles J. Van Depoele, Lynn, Mass.

The switch comprises two or more adjustably-connected members or parts adapted to be attached to the respective conductors at the crossing.

396,314. Commutator Brush Carrier for Electric Motors. Charles J. Van Depoele, Lynn, Mass.

The invention consists in providing a duplicate set of brushes supported in a frame, the frame itself being movable radially upon its supports so as to bring the brushes to any desired position upon the periphery of the commutator, the two sets of brushes being so mounted that by a single movement of an auxiliary handle either pair of the two sets of brushes may be brought into actual contact and operative relation with the surface of the commutator.

396,329. Galvanic Battery. Paul R. de F. D'Humy, Clapham Rise, County of Surrey, England.

396 342. Galvanic Battery. Bernard Scheithauer, Halle-on-the-Scale, Germany.

396,355. Dynamo Electric Machinery. Isaac T. Dyer, Chicago, Ill.

The invention consists essentially in providing the machine with two sets of magnets and movable armatures one within the other.

396,356. Magnetic Separator. Thomas A. Edison, Llewellyn Park, N. J.

The invention is designed for separating mingled magnetic and non-magnetic substances, as bits of iron from wheat, the trajectory of the falling magnetic material being altered by the influence of an electro-magnet.

396,365. Railway Signal. William C. Paul and Oscar D. Kleinsteuber, Milwaukee, Wis.

The invention, which is quite narrow, is stated in the last claim as follows: "The combination, with the electro-magnet and its pivoted armature having a double catch head on its free end of two oppositely-faced cam wheels, and clockwork gearing for driving them, a wrist-wheel carried by the shaft of one of the cam wheels, and levers linked to said wrist-wheel and to the signals.

396,367. Secondary Battery. Isaiah L. Roberts, Brooklyn.

"Claim. The combination, in an electric battery, of a suitable conductor carrying upon it the oxide of a metal with its coated side or sides in contact with a mass of paste, which holds the oxide in place upon the conductor and permits electrolysis."

396,368. Secondary Battery. Isaiah L. Roberts, Brooklyn.

The invention is defined as "a conducting support covered in whole or in part with a salt of a metal, the said salt being formed into a paste and intimately spread upon the supporting conductor, in combination with a pasty mass through which electrolysis can take place, which pasty mass is adapted to hold the salt in contact with the conducting support."

396,369. Secondary Battery. Isaiah L. Roberts, Brooklyn.

The process consists in "covering a conducting support with a metallic salt, enveloping the same in an envelope or bag of suitable material preferably gelatinized fiber, then surrounding the conducting support, salt and bag with a paste, capable of electrolysis, or of permitting chemical action to pass

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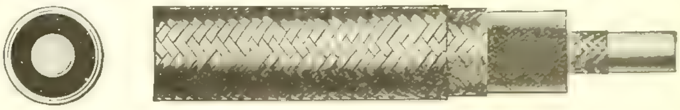

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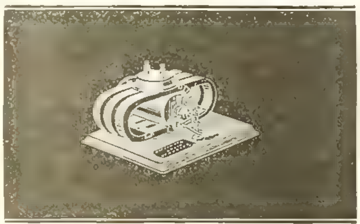

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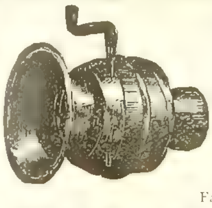

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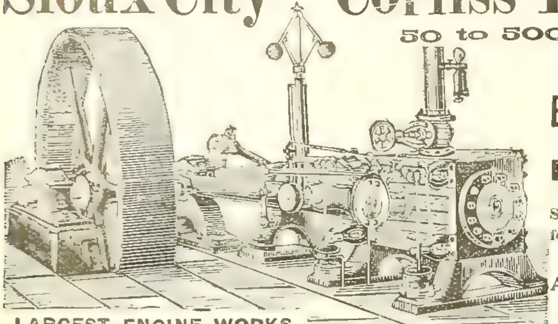

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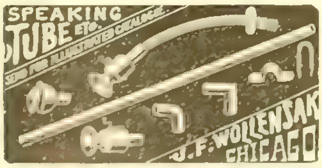

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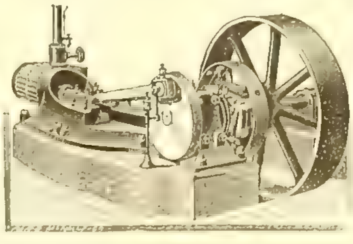

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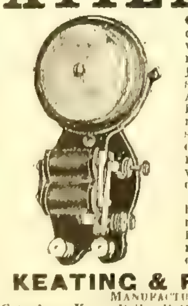

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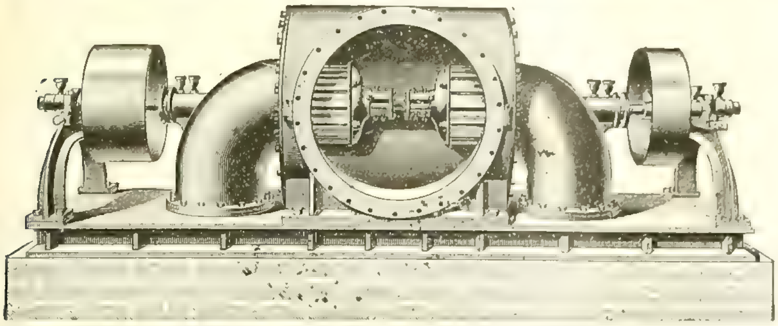

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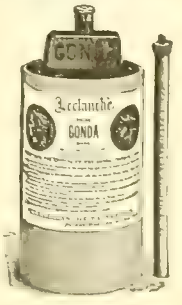

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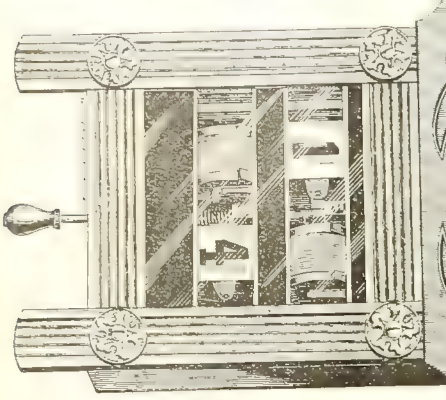

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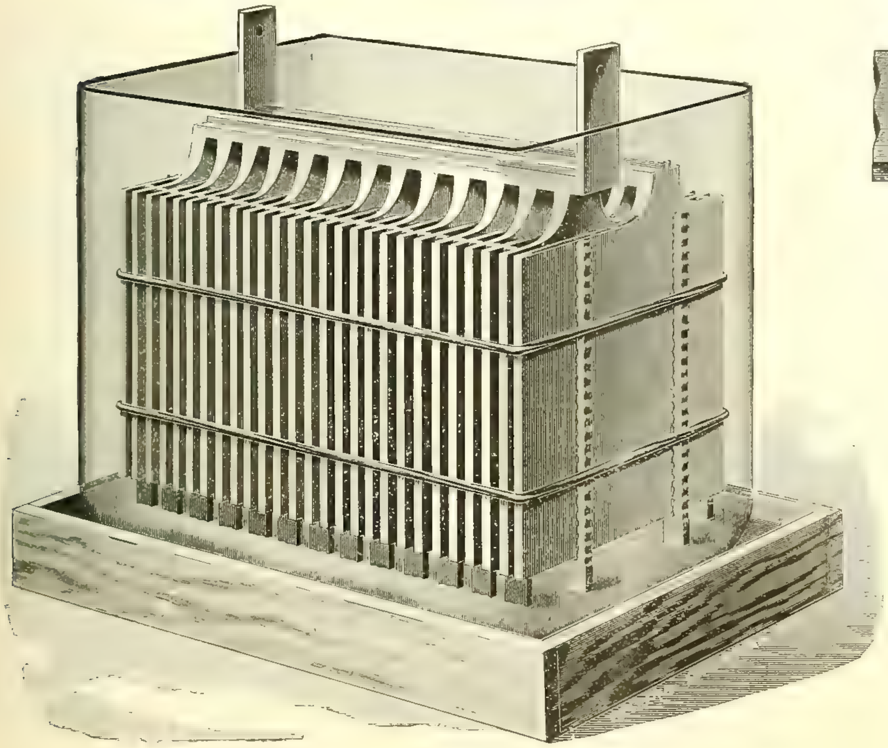

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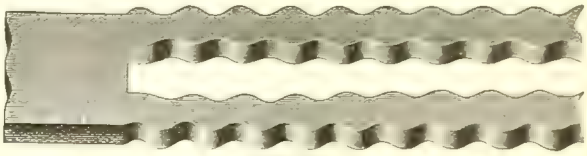

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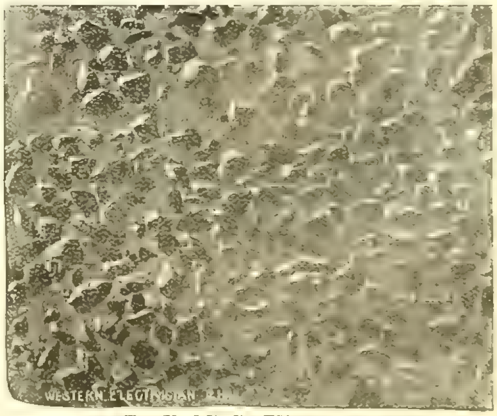

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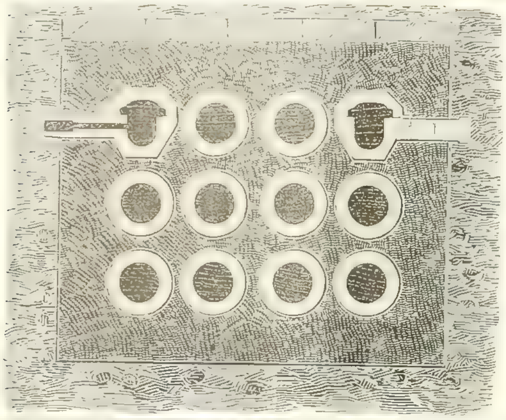

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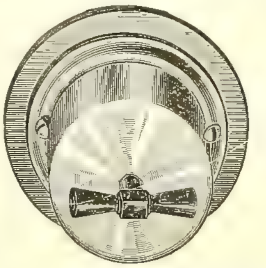

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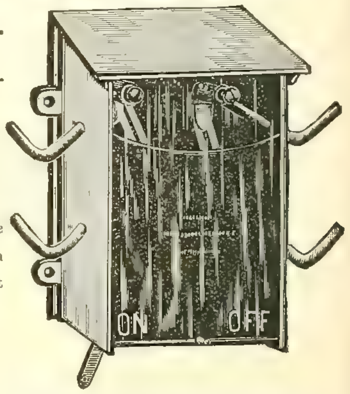

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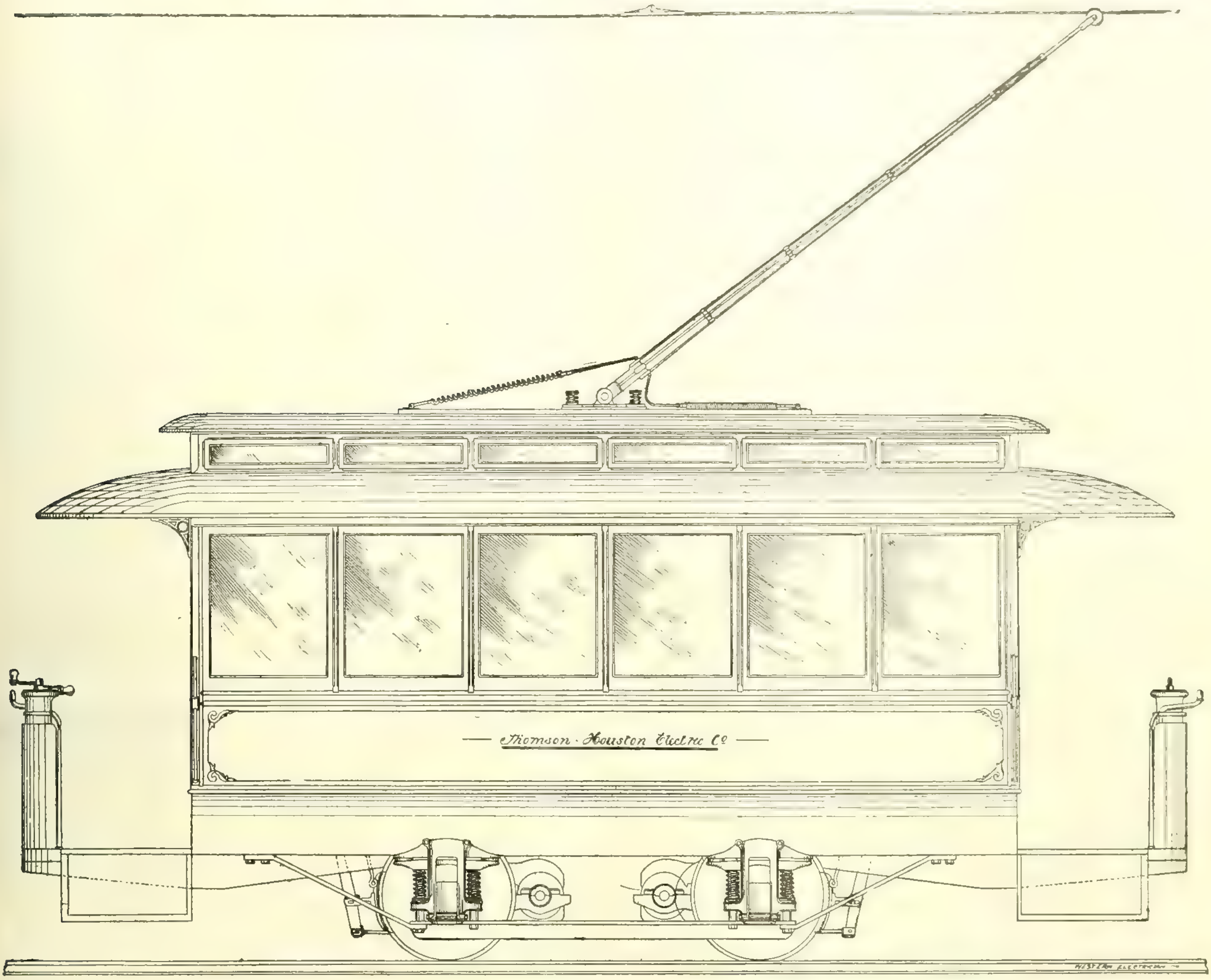

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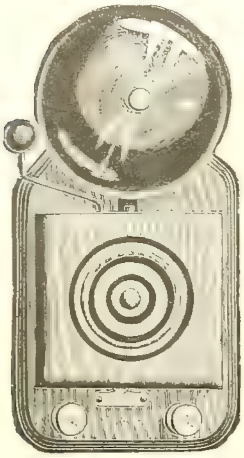

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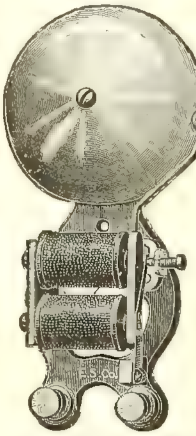

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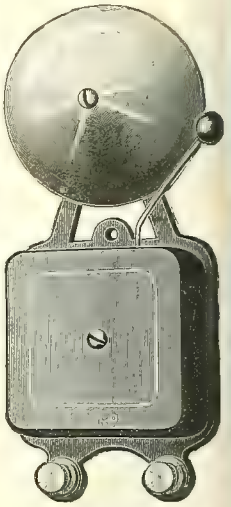

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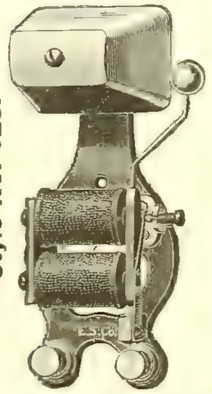

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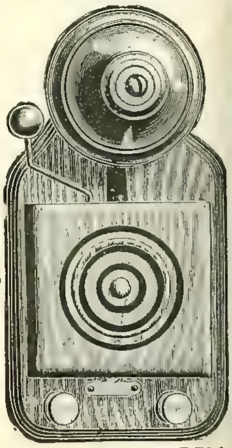

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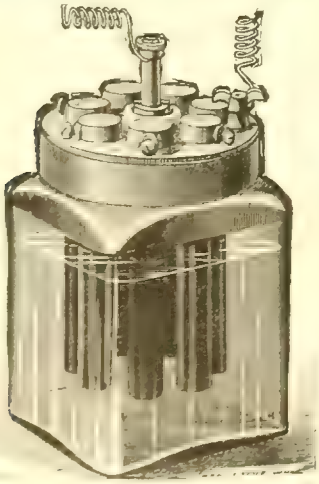

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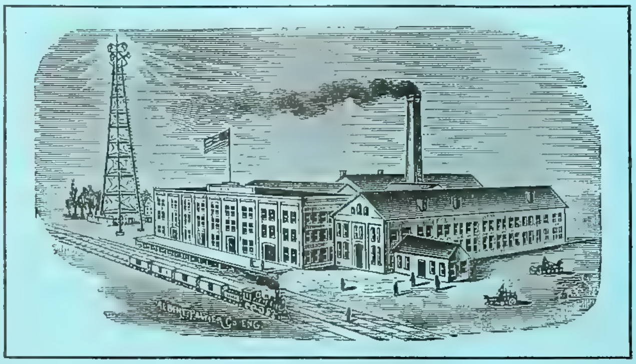

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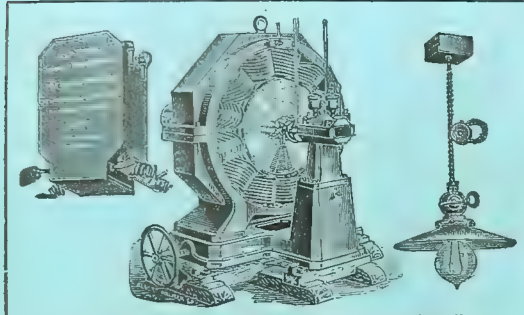

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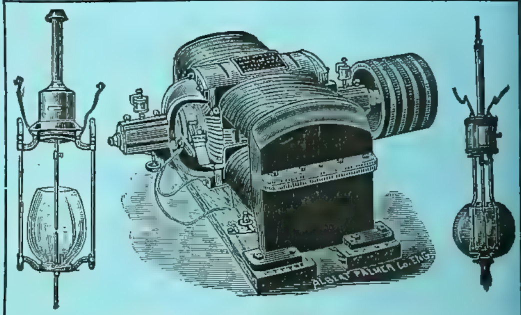

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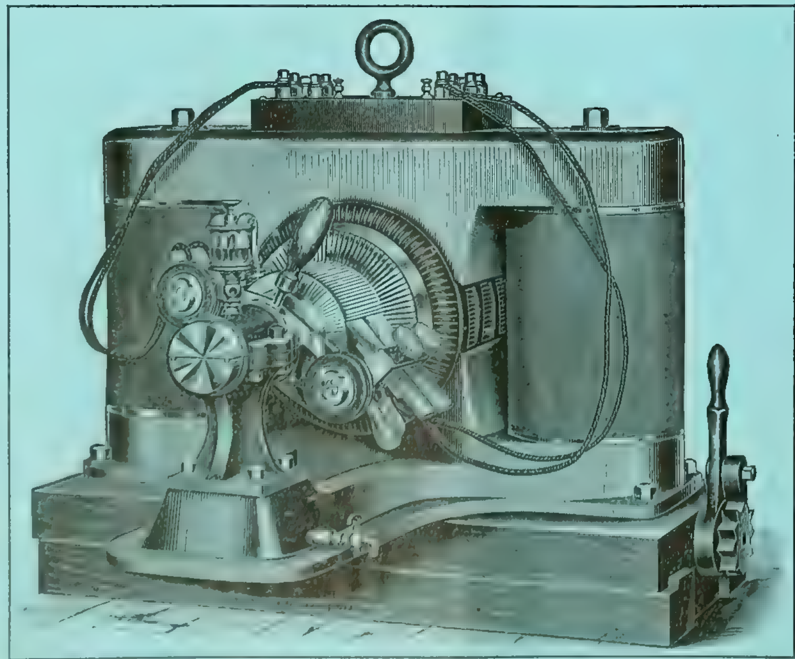

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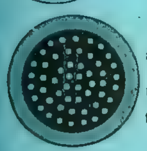

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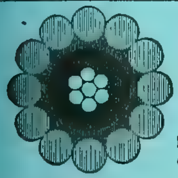

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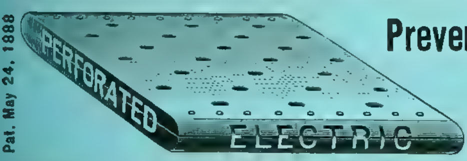

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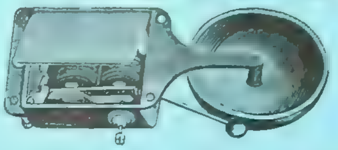

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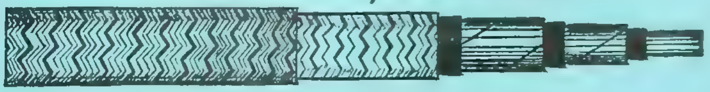

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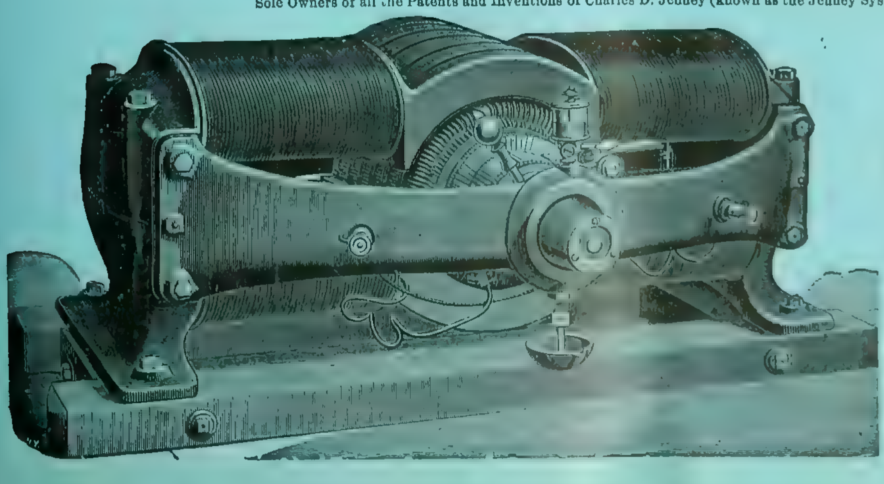

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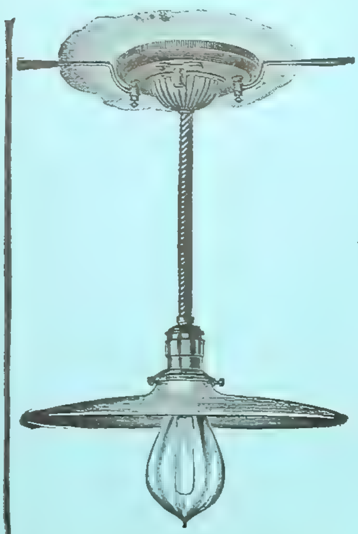

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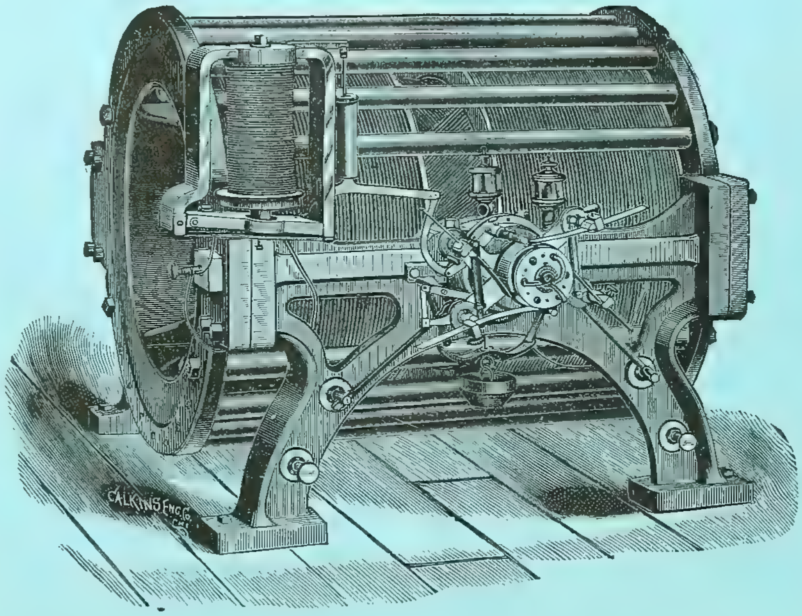

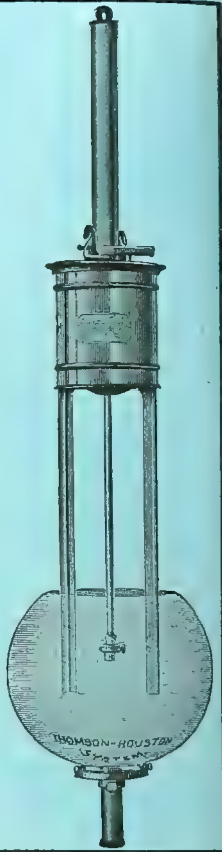

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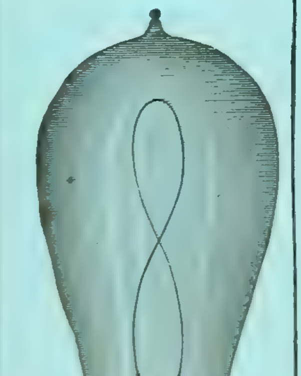

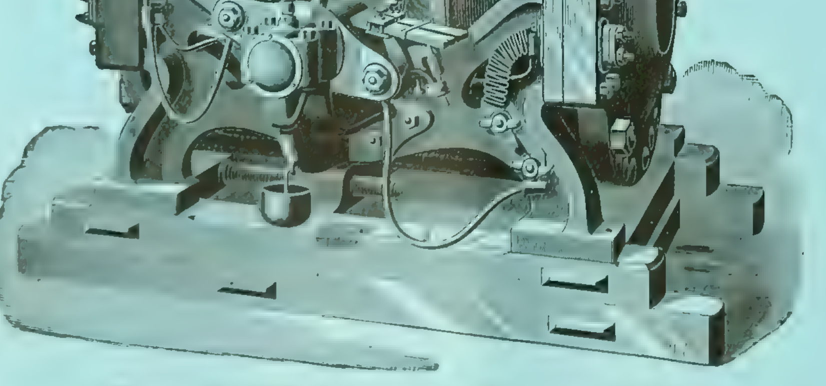

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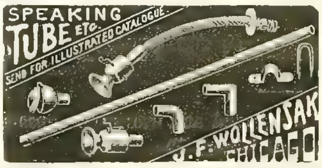

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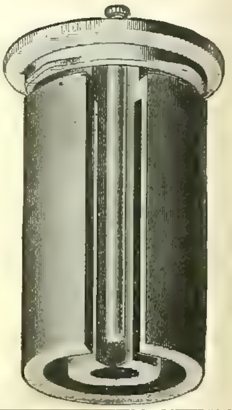

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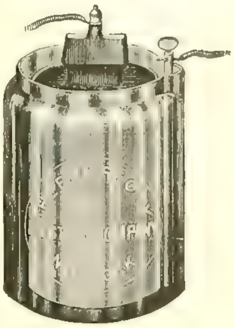

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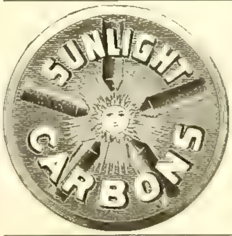

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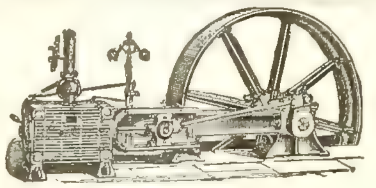

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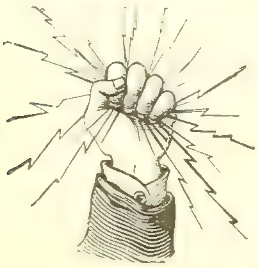

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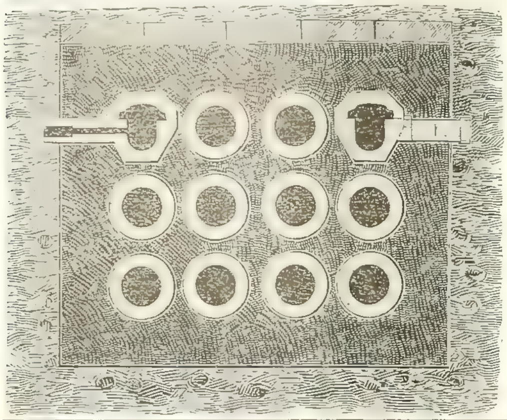

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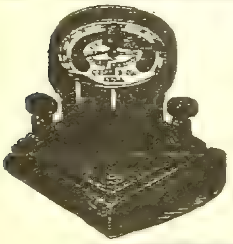

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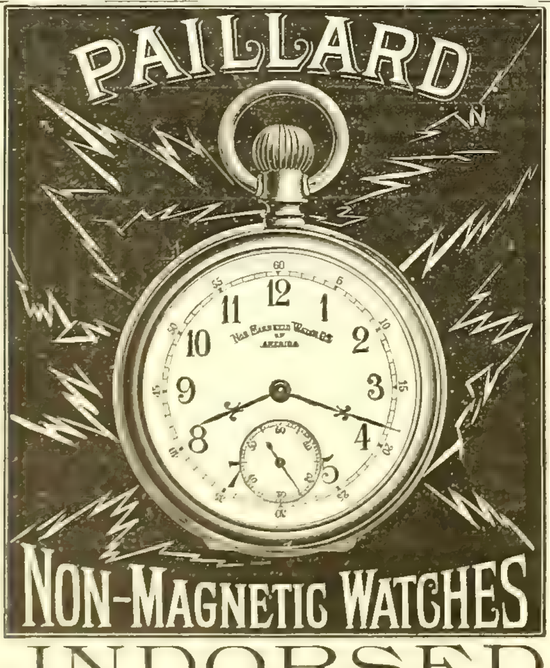

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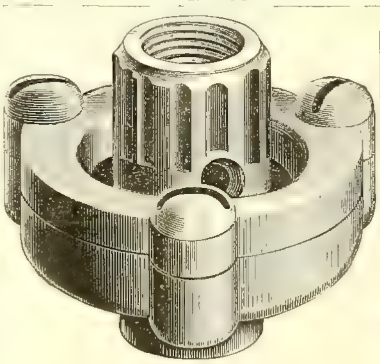

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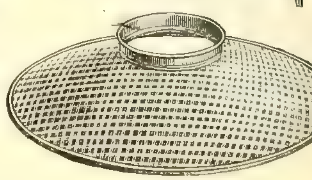

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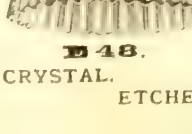

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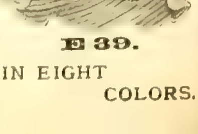

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This Company's Meter measures the whole current by a positive mechanical movement.

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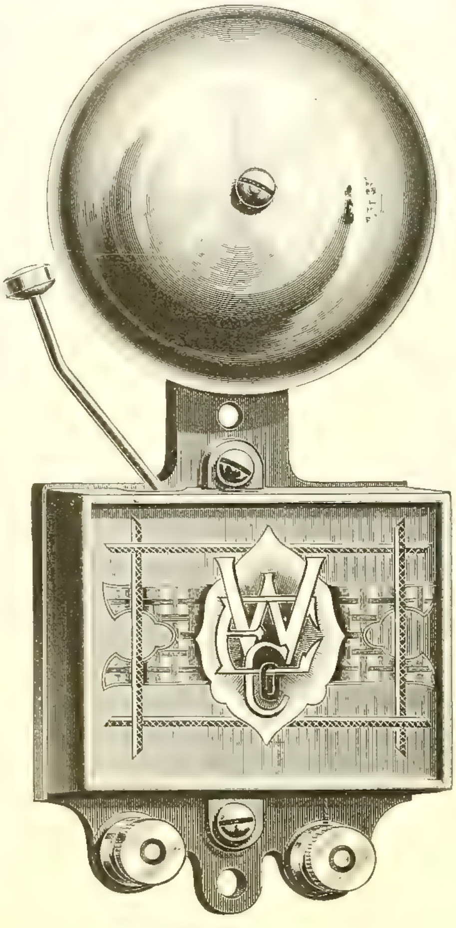

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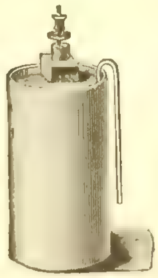

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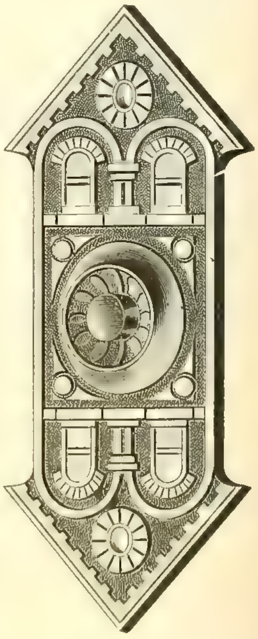

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EVERY SATURDAY.

Vol. IV. CHICAGO, FEBRUARY 2, 1889. No. 5

The New Weston Voltmeter.

A new form of commercial voltmeter is illustrated in the accompanying cuts. The electrical, magnetic and mechanical features have been so worked out as to insure permanence and reliability, coupled with simplicity, extreme accuracy, a wide range of scale reading, and portability. Reference to the cuts will disclose the fact that the field of force is produced by a permanent magnet of peculiar form, while the deflecting body, carrying the index, is a light coil of insulated wire, whose motion, resulting from the dual fields established by the magnet and current circulating in the coil, is restrained by two coiled springs. The springs serve also to convey the current into and out of the moving coil.

That permanent magnets can be, and in fact are, daily made which, after undergoing a process of artificial ageing, remain thenceforth practically constant in strength when subject to ordinary use, is now generally acknowledged. In the construction of these voltmeters special care has been taken not only in the selection of steel and its proper magnetization and artificial ageing, but the magnetic resistance of the acting field has been reduced to its lowest practical limit by the insertion of a central core of soft iron within the movable coil. This core is supported upon the magnet frame by a strap of diamagnetic material. The form of the pole pieces is such that the deflecting coil constantly moves in a uniform field, and hence the deflections practically follow the proportional law, and a direct reading scale, of nearly equal subdivisions, is obtained. The movable coil is wound upon a light frame of copper, which serves the double purpose of a support, and also, since it moves in an intense field of force, as a damper, thus making the instrument exceedingly dead beat.

All important parts of the instrument are made to gauge, and the bearings of the deflecting coil are jeweled. Interchangeability of parts, and the elimination of friction, are thus secured. A difference of potential of about one and one-quarter volts, at the terminals of the movable coil, serves to deflect the index over the entire scale, the length of the scale being about six inches. This degree of sensitiveness permits, therefore, the construction of instruments having a wide range of maximum scale-reading by the simple insertion of differentially wound resistance coils, in series with the movable coil.

The external and internal parts of the new voltmeter are shown in Figs. 1 and 2, having a scale of double values, with a ratio of 20. The scale divisions for the upper values, Fig. 1, are single volts, while for the lower values they read one twentieth of a volt. The single divisions are of such a size that it is easy to read to one-tenth of a division, or to one-tenth of a volt on the upper values and one two-hundredth of a volt on the lower. This form and ratio of scale values are useful for battery work, and especially for storage batteries. The lower scale values are used when examining single cells, or sets of two; and the upper scale values when measuring the aggregate potential difference of a series of cells. In the former case, connection is made with the small binding post under the rubber cap on the left, and with the larger binding post on the right. In the latter case, connection is made with the two large binding posts.

Another important feature consists in the fact that means are afforded those not in possession of laboratory appliances of verifying the scale value by applying a single cell of some constant form, such as that found in any telegraph office, to the terminals of the coil giving the lower scale reading. The deflection noted serves as a standard for future comparison with the same or a similar cell, should doubt arise as to the effect of accidental rough usage.

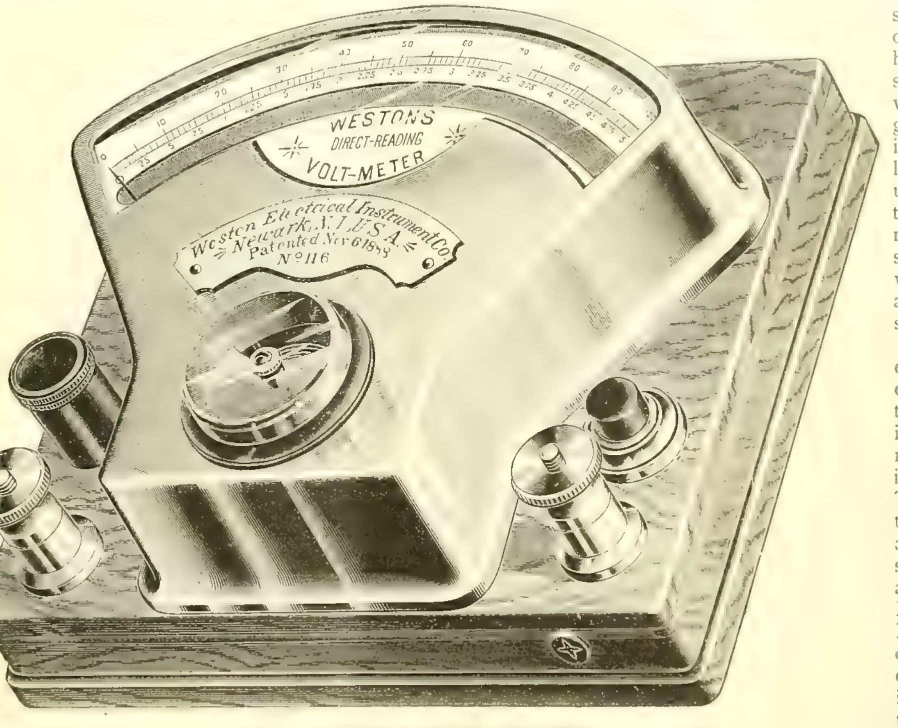


FIG. 1. THE NEW WESTON VOLTMETER.

All scale readings begin at zero, and extend by practically uniform increments to the maximum reading. The range of scale readings for instruments of a given maximum scale is thus greater than is common, and as the divisions of each scale are the result of individual calibration and checking, the scale readings are uniformly accurate. The temperature correction is negligible, and the instruments can be kept constantly in circuit, as their resistance is so high (averaging 20,000 ohms) as to prevent any appreciable heating error.

The Weston Electrical Instrument company of Newark, N. J., which is putting the voltmeter on the market, is also making a new form of ammeter which has the same general appearance as the voltmeter, and possesses the same merits of permanency and reliability.

It is claimed that in the hands of electrical engineers these instruments will afford the means of obtaining results which will be correct within one-fifth of 1 per cent. Special instruments are manufactured to correct within .1 per cent.

Electric Light Convention.

B. E. Sunny, chairman of the executive committee of the National Electric Light association, makes the following statement in reference to the arrangements for the February convention: The board of directors of the Exposition company have contracted to spend $1,500 in putting in steam heat in the art rooms and large dining hall that are to be used by the electric light people. Only one-third of this sum it paid for by the Electric Light association, and the remainder is practically offered as a bonus to secure the meeting. The directors are very much interested in the exhibit features, and are offering every facility to make the convention a complete success.

As has already been stated, they are desirous of having an electric exhibit at an early day, possibly within a year, that will completely fill the great building, and will include everything in the line of electric manufactures. The large space at the disposal of the committee is practically spoken for now, and it will be quite difficult to arrange for any more space in the rooms taken.

The Thomson-Houston electric railway and a car equipped with storage batteries will be the features in the line of electric railways. The motor service will be represented by Thomson-Houston, Baxter, C. & C., Brush, Belding and Eddy. Arc light systems in practical operation will be the Thomson-Houston, Brush, Sperry, Excelsior, and perhaps one or two others. At least three companies will illustrate in practical operation their incandescent systems. The tickets of admission are now being printed, and will be ready for distribution inside of a week. Although 100,000 tickets have been ordered, it is probable more will be required if the demands of the exhibitors for tickets for their friends and correspondents up to date is any criterion. Among the other exhibits to be made is the magnificent one promised by the Non-Magnetic Watch company, the Phœnix Glass company, and the appearance of the rooms will be very much beautified by the addition of the resplendent wares of the electrolier manufacturers. Applications for hotel accommodations are being made daily, and from all indications there will be a very large attendance of ladies. The [illegible] feet of track for the electric railway will be constructed in a week. This work is being done by C. B. Holmes of the Chicago City Railway company, whose interest in the advancement of rapid transit, especially from the electrical standpoint, is well known. The track will have one curve of fifty foot radius, so that the electric railway

men will have an opportunity to show how their respective systems perform on a curve.

Paris Electric Light Grants.

Enos M. Barton, president of the Western Electric company, Chicago, has returned from his trip to Europe. In speaking of electrical news on the other side of the Atlantic, Mr. Barton said to a representative of the WESTERN ELECTRICIAN: "The matter which seems to be exciting the greatest interest just at present is the recent grant in Paris to the electric light companies. Permission has been granted to six companies to establish electric light stations. The city is to be divided into six districts. The dividing lines are from the center of the city to the outskirts, so that each company has a portion of the central section, and considerable part of the outside districts to light. The condition of the grants is that the outskirts shall be served just as well as the center of the city. It is provided that a considerable sum of money —300,000 francs, I think—shall be deposited by each company as a guarantee that it will avail itself of the privileges granted it.

"The circuits will be underground and will be run through the sewers as far as possible. It is estimated that in order to avail themselves of the privileges, the companies will be obliged to supply 240,000 incandescent lamps in addition to arc lights. It is thought that the aggregate horse power will be about 80,000. The manufacturers as a result of the grant are anticipating an unusually busy year.

"In Berlin not a great deal has been done in electric lighting since my last visit there. The arc lamps employed are smaller than those which are generally used here. They are of [illegible] candle power. The streets on which they are placed are well lighted as the lamps are put close together. The system [illegible] gives a very steady light."

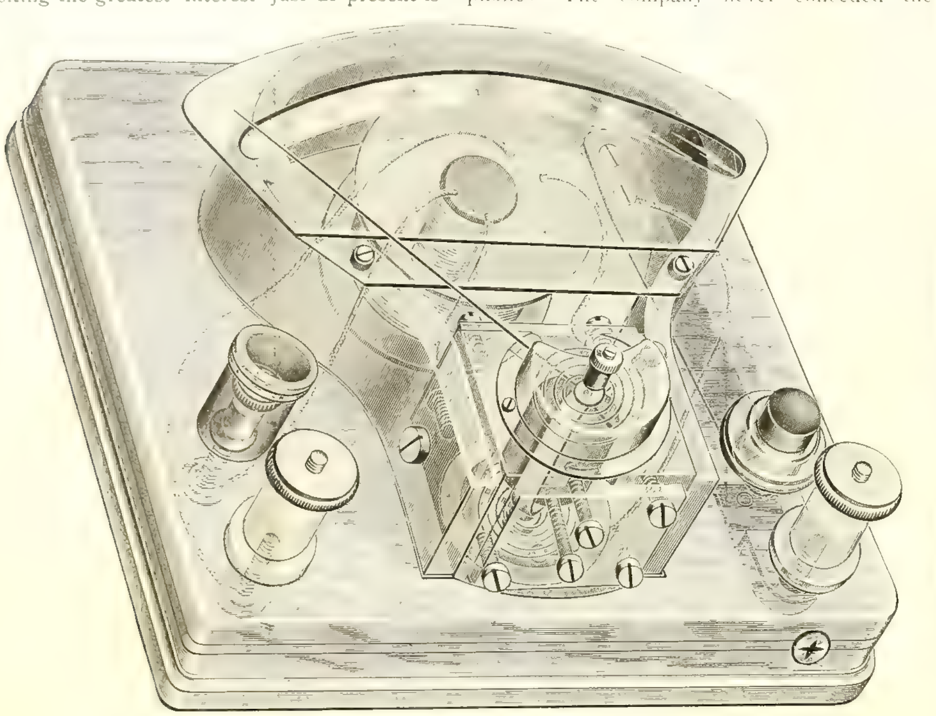


FIG. 2. NEW WESTON VOLTMETER.

New Alternating System.

It [illegible] Depoele Electric company [illegible] introduce an alternating system. It is reported that the first dynamo [illegible] about two weeks, and [illegible] It will probably [illegible]

[illegible] bright- [illegible]

Chicago Telephone Extension.

The Chicago Telephone company is contemplating many improvements in its service, and is extending its lines rapidly under the ordinance adopted by the city council recently. The bond presented by the company has been accepted and filed by the city, and the work of putting in new instruments was begun immediately. It is now nearly a year since the telephone company, in compliance with the ruling of the city officials, ceased introducing new telephones. The company never conceded the city's right to interfere, but did not assert what rights it may have had in the matter temporarily, and adopted a conciliatory course rather than oppose the action of the council. This has been the policy of the company since its organization. Feeling that there was a prejudice in the minds of many people against it, in common with similar enterprises, the company has granted every reasonable request that has been made, and, by studying the wants of the subscribers and increasing the efficiency of the service, endeavored to overcome this uncalled-for and undeserved opposition.

One of the changes contemplated was the closing of the branch office at Desplaines and Washington streets, and transferring the force to the main office. Last week the work of constructing an underground conduit between these points was in progress, and it is hoped that the weather will permit its speedy completion. This change will add 600 telephones to the number now directly connected with the main office. When the company ceased extending its lines a year ago it had upward of 4,700 telephones in use, and during the year it has received over 500 applications for new instruments. These will be put in as soon as possible.

Electric Light Bills in the Town of Lake.

The failure of the town of Lake which adjoins Chicago, to pay its electric light bills, has brought to light a curious state of affairs. It appears that during the last two years the town has not paid the bills of the Arc Light & Power company of Chicago, which furnishes its public light, and its indebtedness to the company exceeds $8,000. The town officials have been putting off the company with promises until B. E. Sunny, president, notified the officials that unless they came to time the light would be shut off February 1st. This rather surprised the town people. They had not anticipated such a determined stand, and they have since been endeavoring to straighten matters. It appears that there is no money in the gas fund, upon which the warrants of the electric light company are drawn, and the officials do not care to put any money in the fund, as the gas trust, which has made itself obnoxious to the people of Lake, has large claims prior to the electric light company's, and would secure all the money in the fund. Residents of Lake are satisfied with the service of the electric light company, and no complaint against it is heard, but there is widespread dissatisfaction with the course of the gas trust, and it is against that corporation that the town council has been working. The electric light company, however, does not feel disposed to suffer, in order that the town may vent its spite upon the gas trust.

Electric Motor in a Newspaper Office.

The room in which the cuts for the Chicago *Tribune* illustrations are made contains considerable electrical apparatus. The photographs from which the zinc etchings are produced are taken by the light of two arc lamps. The machinery in the room is operated by a three-horse power Sprague motor, which was recently installed by the Chicago office of the Sprague Electric Railway & Motor company, C. M. Barclay, manager. The installation is a remarkably interesting one. The motor is compact and occupies but little space, a feature which is of extreme importance in the photographing room. The motor works admirably, and there is no perceptible sparking of the brushes. The motor is provided with self-oiling bearings. Current is taken from the Edison circuit.

Agreement of the United States and Westinghouse Companies.

Following is the official announcement of the agreement entered into by the Westinghouse and United States companies:

It is announced that an agreement has been made between the Westinghouse Electric company and the United States Electric Lighting company, whereby the interests of these two companies shall hereafter be conducted for mutual benefit, both in the manufacture and sale of electrical apparatus, and in the management and litigation of their patents.

The United States company is one of the oldest electrical manufacturing companies, and has a large and growing business in arc and incandescent lighting, and plating apparatus, motors, and alternating current apparatus, a large factory in Newark, N. J., and many electric light and power plants in use.

It holds many strong patents; some of which are fundamental, its inventors having been the earliest in the field of practical electric lighting and transmission of power.

The Westinghouse company has, in two years, taken the lead in central station lighting, having 143 stations, with a total capacity of 250,000 16-candle power lamps in service. It is the lessee of the Consolidated and Sawyer-Man Electric companies of New York, and has in addition to its own

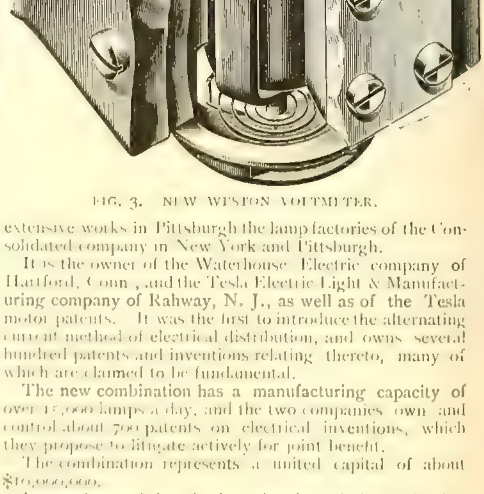


FIG. 3. NEW WESTON VOLTMETER.

extensive works in Pittsburgh the lamp factories of the Consolidated company in New York and Pittsburgh.

It is the owner of the Waterhouse Electric company of Hartford, Conn., and the Tesla Electric Light & Manufacturing company of Rahway, N. J., as well as of the Tesla motor patents. It was the first to introduce the alternating current method of electrical distribution, and owns several hundred patents and inventions relating thereto, many of which are claimed to be fundamental.

The new combination has a manufacturing capacity of over 15,000 lamps a day, and the two companies own and control about 700 patents on electrical inventions, which they propose to litigate actively for joint benefit.

The combination represents a united capital of about $10,000,000.

It is understood that the Bate decision relating to foreign patents, just rendered by the United States Supreme Court, is regarded by these companies to be greatly to their advantage in strengthening their own position, as well as that of patents in general.

Insulation Brackets.

The progress made in the last two years in line construction and in devices used in the work, has been marked. The construction of electric light, telegraph and telephone lines under all conditions in pole and housetop work seems to have been carefully studied, and the required devices may be readily obtained. In this connection considerations of high insulation are of the most vital importance. Electric com-

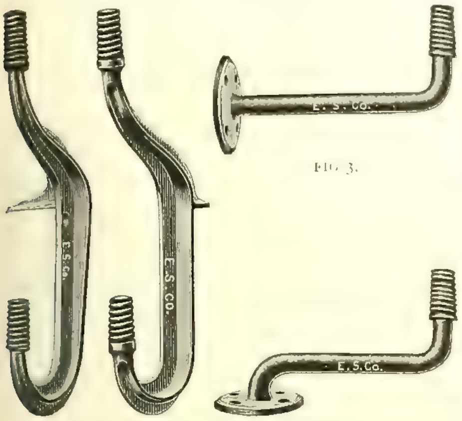


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

INSULATION BRACKETS.

panies have found that high insulation is a great essential of commercial success. Illustrated herewith is a complete system of special wire brackets and appliances. The brackets possess advantages over the ordinary insulator support and sockets, in that the insulator itself is always held in an absolutely upright position, so that moisture cannot get under it and destroy its insulating properties. They are adapted for the use of any standard insulator.

Figs. 1 and 2 show a new form of loop or spreader bracket, the former for lateral attachment, and the latter being for forward projection. These are attached upon cross-arms or other suitable supports, and take the wires from the insulators upon the cross-arms, forming the terminal of the service loop. Fig. 3 shows a wall bracket for brick, stone or other walls. The wires are led from the spreader arms to these wall brackets, thence down to the window, service wires, converter, or other devices to be supplied. Fig. 4 represents an offset roof bracket, by means of which insulators are securely fastened to roofs or attached to cornices for the purpose of leading down wires at the edge of the cornice, at a considerable distance from it, or from the walls. Fig. 5 represents a straight roof bracket, the purpose of which is the same

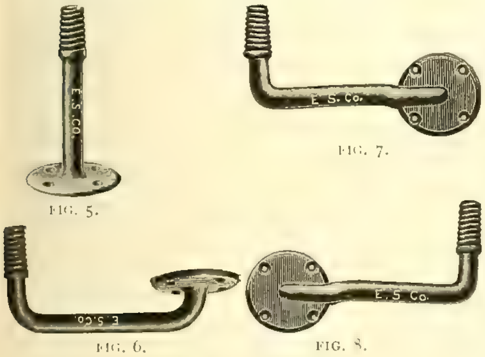


FIG. 5. FIG. 6. FIG. 7. FIG. 8.

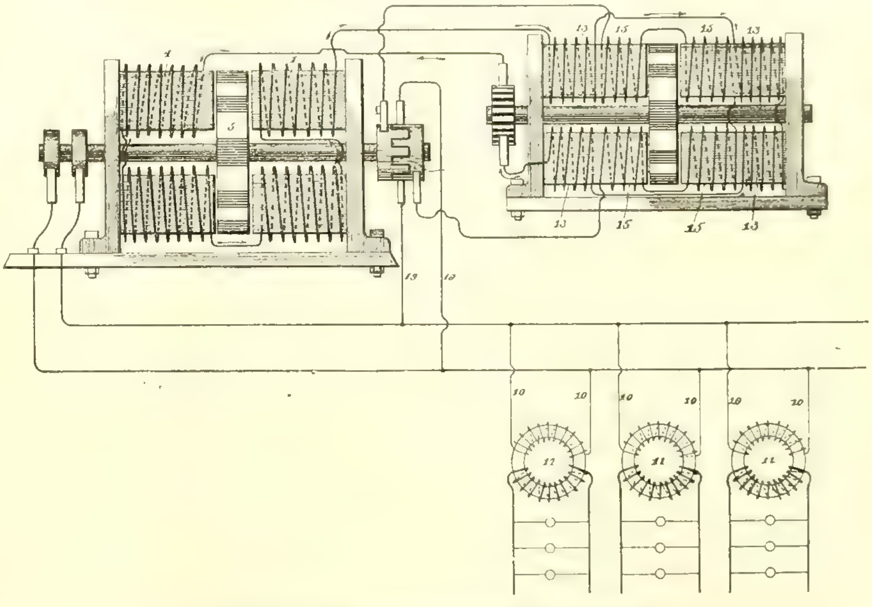
INSULATION BRACKETS.

as Fig. 4. It is also useful for utilizing the extreme top ends of uprights upon roofs and walls which are used in supporting cross-arms. Fig. 6 is a cornice bracket. It is often very difficult to secure insulators upon cornices without inverting the insulator or holding it at such an angle that the moisture will destroy its insulating properties, but by the use of this bracket the insulator may be supported in an upright position, and yet project at any desired angle. Figs. 7 and 8 are lateral brackets, which are used for corners of buildings. They are made both right and left, and may be fastened to stone, brick, or other walls, supporting the insulators always in an upright position. The brackets are put on the market by the Electrical Supply company of Chicago.

Regulation of Alternate Current Generators.

The accompanying cut illustrates an invention for the regulation of alternate current generators, recently patented by Gustav Pfannkuche of Cleveland, O. The following description is given of the use of the invention in a system of distribution:

The prime generator and the exciting dynamo are started simultaneously. The current from the latter energizes the field magnets of the former, and the strength of the field depends upon the strength of current force from the exciter. This exciter, in so far as it is an ordinary self-exciting dynamo, will furnish a current depending upon its construction and speed; but in so far as its auxiliary field coils are fed by a shunt across the brush terminals of the alternating current generator, the strength of its field, and consequently, the strength of current generated by it, will also depend upon the relation of the external resistance to the total resistance of the prime generator. Supposing, then, that both machines are started when a given number of translating devices, like the secondary transformers 11 11, are at distant points included in multiple arc branches from the main line, and that in that condition of the system the alternating current generator furnishes the required current to the line, and produces the required difference of potential; if, now, additional multiple arc branches 10 10 are introduced, the



REGULATION OF ALTERNATE CURRENT GENERATORS.

external resistance of the prime generator will be reduced, and consequently the difference of potential at the brush terminals of generator 1 will at once decrease, while at the same time more current will be generated, as required by the increased number of translating devices. In consequence of the decrease of difference of potential, less current than before will be diverted through the shunt 19 19 into the auxiliary field coils 15 15 of the exciting dynamo. These coils will therefore oppose the magnetizing action of the normal coils 13 13 less, and the field of force of the exciter will consequently become stronger. The exciter will now furnish a stronger current to the field coils 4 4, etc., of the alternating current generator, and the difference of potential at the brush terminals of the latter will therefore be increased. Thus it is seen that such change in the external resistance as will tend to decrease the difference of potential at the brush terminals will automatically operate to re-establish or maintain the original difference of potential. If, on the contrary, some of the multiple arc branches 10 10, etc., are opened and the external resistance of the line increased, less current will be generated in armature 5, and the difference of potential at the brush terminals will be increased. Consequently more current will be diverted into shunt 19 19 and auxiliary coils 15 15 of the exciter. These coils will more oppose the action of normal coils 13 13, as before, and the field of the exciter will be weak- [illegible] tial.

It is claimed that the system will [illegible] branches or by any other cause for it responds to and reacts upon variations of differences of potential irrespective of the causes which produced or tend to produce the same. No artificially introduced resistances and no manipulations of any kind are necessary to the [illegible] operation of the invention, which is absolutely automatic.

The following claims are made in the patent specification:

"1. The combination, with an alternating current dynamo, of a separate exciting dynamo having its field magnets provided with two sets of coils, one set being included in the circuit of the field magnet coils of the alternating current dynamo, and the other set being included in a shunt across the brush terminals of the alternating current dynamo.

"2. The combination, with an alternating current dynamo, of a separate exciting dynamo having its field magnets provided with two sets of coils, one set being included in the circuit of the field magnet coils of the alternating current dynamo, and the other set being included in a shunt across the working circuit, and a commutator included in the shunt for strengthening the current to the set of field coils therein.

"3. In a system of electrical distribution, the combination of a separately excited alternating current generator having its field coils charged by self-exciting dynamo, with auxiliary differential coils upon the field magnets of the exciter in a shunt across the brush terminals of the alternating current generator, and a commutator for straightening the currents in the shunt.

"4. The combination, with an alternating current dynamo, inductoriums in multiple arc branches of the main line from the alternating current dynamo, and translating devices included in the secondary circuits of the inductoriums, of a separate exciting dynamo having two sets of field magnet coils, one set being included in circuit with the field magnet coils of the alternating current dynamo, and the other set included in a shunt from the main line."

C. K. Huntley of the Brush Electric Light company of Buffalo was in Chicago last week. He had been in Milwaukee where he purchased of E. P. Allis & Co., a 1,500 horse power triple expansion engine, which will be placed in the company's new central station in South Buffalo, three miles from the center of the city. A considerable number of small engines will be displaced. The company is operating about 1,000 arc lamps, and is furnishing current for motors with an aggregate capacity of 150 horse power.

The Bate Refrigerating Case.

BY [illegible]

On January 21st the United States Supreme court rendered its decision in the suit of the Bate Refrigerating company against George H. Hammond & Co. The issues were specially made up for the purpose of obtaining an expression from the court as to the right construction of the statute relating to the limitation of the terms of the United States patents to the terms of prior foreign patents. This section of the statute is as follows:

Sec. 4887. No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years.

The decision of the Circuit coutts have been that an invention secured in this country by a patent issued after a foreign patent for the same invention, becomes public property at the end of the original term of the foreign patent, even though the term of the foreign patent had been extended, so as to keep the foreign patent in force, and notwithstanding the application for the United States patent was filed first.

The legal questions involved were considered of such importance to various electric light companies that they were represented by counsel. It was contended on behalf of the Refrigerating company.

"First. That the words 'first patented or caused to be patented in a foreign country,' do not mean, 'first patented, or caused to be patented,' before the issuing, or granting, or date, of the United States patent, but mean 'first patented, or cause to be patented,' before the date of the application for the United States patent.

"Second. That the declaration of the section, that 'every patent granted for an invention which has been previously patented in a foreign country, shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one at the same time, with the one having the shortest term,' does not mean that the patent so granted shall expire at the same time with the term to which the foreign patent was in fact limited at the time the United States patent was granted; but it means that it shall expire when the foreign patent expires, without reference to the limitation of the term of such foreign patent in actual force at the time the United States patent was granted."

The court, by Justice Blatchford, sustained this second proposition, finding it unnecessary to consider the first.

The court, after reviewing various decisions of the Circuit court, holding the contrary of this proposition, says:

"We are of the opinion that, in the present case, where the Canadian statute, under which the extensions of the Canadian patent were granted, was in force when the United States patent was issued, and also when that patent was applied for, and where, by the Canadian statute, [illegible] of the patent for Canada was a matter entirely of right, at the option of the patentee, on the payment of a required fee, and [illegible] years' term of the Canadian patent has been continuous and without interruption, the United States patent does not [illegible] fifteen years' dura[illegible]

[illegible] that prior [illegible] Canadian, Austro-Hungarian, [illegible] years, [illegible] the prior foreign pat[illegible]

[illegible]ntry.

[illegible]

last spring, it was held that Edison's patent No. 263,140, dated August 22, 1882, filed August 9, 1880, was void on account of the Austro-Hungarian patent for the same invention, granted July 21, 1881. It appears, however, that the Austro-Hungarian patent was only kept in force until July 21, 1883. The principal question involved in this Edison suit was thus the first proposition which the Supreme court has left untouched.

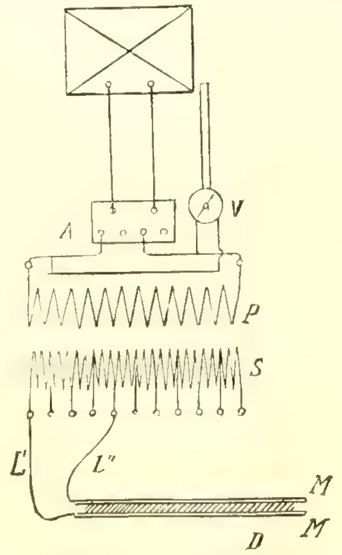
The decision, however, is a victory for the Edison company in those cases where they have kept their foreign patents alive.

Justice Blatchford, in 1889, speaking for the Supreme court, reverses, Judge Blatchford sitting as Circuit judge in 1879, he having held in Reissner *vs* Sharp (16 Blatchford 383), that the patent involved expired with the first five year term of the Canadian patent, although the Canadian patent had been extended, and was in force at the time he gave his decision. It will be seen, however, that the most interesting of the two questions presented is still left open.

Justice Blatchford, in the case of Gramme Electrical company *vs.* Arnoux & Hochhausen Electric company, decided in 1883, held that the date of the filing the application for the United States patent does not, in any way, relieve the patentee of the statutory limitation, and this is thought to be the correct opinion. The final determination, however, must be left for the Supreme court, when the precise point raised by the first proposition shall be brought before it.

A 10,000-Volt Transformer for Testing Insulation Resistance.

The ordinary tests of insulation, consisting only of a measurement of the insulation resist-



TEN THOUSAND-VOLT TRANSFORMER.

ance, under the comparatively low e. m. f.s usually available, afford very little guarantee, especially in the case of electric light cables for the working strength of the insulation. It therefore seems very desirable to take advantage of the facilities afforded by alternating currents to test such cables under much higher e. m. f.s than they will be subjected to in practice, says the London *Electrician*.

At the Menier Electric Cable works in Paris-Grenelle, an alternating current transformer, made by Ganz & Co of Budapest, has been used since March, 1888, for the purpose of testing cable insulation, or any other dielectric resistance. This transformer is constructed with a primary coil, *P*, for 100 volts and 70 amperes, and a secondary, for 10,000 volts and .67 amperes, the ratio of transformation being 1:1[illegible].

The secondary coil is divided into ten divisions, the ends of which are led to metal contact pieces with conical holes. By means of two plugs and two flexible leads *L' L"*, the dielectric to be tested can be subjected to a difference of potential of from 1,000 up to 10,000 volts, and [illegible]

In the primary circuit there is, as well as the [illegible], a double pole switch, *A*, in order to [illegible] the primary circuit entirely before altering the secondary difference of potential by shifting plugs. A Cardew voltmeter is used for the control of the primary tension.

Concerning the construction of the transformer it may be mentioned that the primary and secondary coils, as well as the divisions of the secondary, are carefully insulated from one another with ebonite. The metal pieces forming the terminals of the secondary divisions are mounted on high ebonite supports, the metal plugs being also furnished with long handles of the same material.

The transformer, together with the terminals, is mounted on a strong base board, on which there is also a double pole switch with porcelain base and handle.

This method of testing the insulation of cables obviously affords a far better guarantee of their safe working in actual use than that of testing by measuring the insulation resistance with a comparatively low e. m. f., for it may happen that a layer of insulation which shows with only a few hundred volts an infinitely good resistance, could be broken through by a few thousand volts.

Standard of Insulation for Electric Light Circuits.

BY G. E. FISH.

In establishing a standard insulation for electric light circuits three questions are to be considered. The first and most important is to guard against danger to human life; second, to guard against fire, and third, the cost of maintaining this standard. Ohm's law shows that the quantity of electricity passing through a conductor is equal in amperes to the electromotive force in volts divided by the resistance of the conductor in ohms. If a man comes in contact with the conductor of an arc or incandescent circuit a current will pass through him, which will be equal to the electromotive force of the current passing through the conductor divided by the resistance of his body added to the resistance of the insulation of the circuit. This assumes that the man is standing on damp ground, or is in some position in which he is not perfectly insulated. If one terminal is grounded, and if he grounds himself at the other terminal at the time he comes in contact with the conductor, which is carrying a 1,000-volt current, he will receive in his body current equal to 1,000 volts, divided by 5,000 ohms or .2 amperes.

I have measured the resistance of several men from hand to hand, and find that they average from 4,000 to 15,000 ohms. As it is a generally accepted fact that 1,000 volts will kill a man, and assuming from the above test that the average resistance of the human body is 5,000 ohms, we get by Ohm's law $\frac{1000}{5000} = .2$ ampere, which would go to show that the quantity of current that will destroy human life is two-tenths of an ampere.

A gentleman who is well informed in electrical science claims that one-tenth of an ampere is all that is required, but I once had an opportunity of disproving the statement. An employe was connecting a testing device to be used on a dynamo that at the time was running with thirty-two arc lights. The potential had been taken a few moments before, and was found to be 1,300 volts. The device was to be shunted across the terminals of the dynamo. At the time one side of it was connected, a short wire was hanging from the other side. The man was at work on a wire from the opposite terminal of the dynamo when he accidentally touched the end of the free wire, receiving through his body the 1,300 volts. The resistance of the testing device was 5,580 ohms, and of his body, from hand to hand, 6,000; so that he got a current equal to these two resistances added (11,580 ohms), divided into the 1,300 volts, or .12 ampere. Had not the 5,580 ohms' resistance been between him and the opposite pole of the dynamo there is no question but that he would have been killed. In that case he would have received $\frac{1300}{6000}$ = .21 ampere.

Assuming that .2 ampere is the quantity of current we must provide against, let us determine on an insulation. For example, we will

take a circuit of fifty arc lights and a current [illegible] 2,500 volts, the insulation of the circuit measuring infinity, except at a point at the negative pole, where it is a megohm. If a man comes in contact with the conductor at the positive pole a current will pass through him equal to

$\frac{2500}{1000000 + 5000} = .0024$ of an ampere. [illegible] now assume that the insulation of the circuit is a megohm equally distributed. We have fifty lamps with a potential of 2,500 volts, or fifty volts to the lamp, and a total insulation of 1,000,000 ohms, or 50,000,000 ohms to each space between lamps. There will be a certain amount of leakage from each of these spaces, as shown in the diagram:

The dotted lines represent the leakage. The insulation from one lamp to another is $\frac{50000000}{2}$ or 25,000,000, and, with a potential of 100 volts (two lamps), we have a leakage or "eddy current" of $\frac{100}{25000000} = .000004$ of an ampere.

The man of 5,000 ohms' resistance comes in contact with the conductor at some point along the circuit, forming a shunt of $\frac{50000000 \times 5000}{50000000 + 5000}$ $= 4,997$ ohms. Now, as he has only shunted one side of the circuit, he will get a current in proportion to the resistance of the other side, and the current will be equal to $\frac{50000000 \times 9997}{50000000 + 9997}$

$\frac{100}{4996} = .02$ of an ampere, which is not at all dangerous.

Let us now assume that the circuit measures infinity, except at a point near one terminal, where it is 12,500. If he comes in contact with it at the opposite pole he will receive a current of $\frac{2500}{12500 + 5000} = .14$ of an ampere, which, while perhaps not dangerous, would be very uncomfortable.

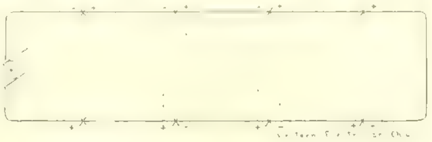
If we distribute the 12,500 ohms equally, as in the case of the megohm circuits, we get $12,500 \times 50 = 625,000$ as the insulation of each space, which, divided by two, gives us 312,500 as a path for 100 volts, or a current of .00032 of an ampere. From this we may assume that an insulation of 12,500 ohms equally distributed is perfectly safe for a fifty-light circuit, so far as any danger to life is concerned, and we may settle upon an insulation of five times the e. m. f. as a standard. As an example of the employment of this rule, let us take the following: A 20-light arc circuit, 45-volt lamps, $20 \times 45 \times 5 = 4,500$; $\frac{900}{4500 + 5000} = .095$ ampere, which we have shown is perfectly safe. Or we will take an incandescent circuit of 220 volts; $220 \times 5 = 1,200$; $\frac{220}{1200 + 5000} = .037$ of an ampere.

As to the fire question, let us first determine what causes the fire. If the wire used is of the same size as that at present employed there can be no danger of its becoming heated, so we must look to the insulation. If the current could not leak from the wire there would be no danger, but it does get away, and it escapes through the defective insulation. It is my opinion that the fire is caused by the current heating this defective insulation as it passes through it, and that heating will be in proportion to the amount of current flowing through it. For instance, if a current becomes "dead" grounded on one side, there is no danger, except that of forming another ground or an escape between the ground and the point of lowest insulation, which escape will be in proportion to the e. m. f. between those two points. Now, suppose another ground does come in; so long as neither of them offers any resistance there can be no danger, but if instead of a ground it is an escape of 500 ohms, and the potential is 2,000 volts, there will flow through this escape a current of $\frac{2000}{500} = 4$ amperes. If the material through which it is flowing is of an inflammable nature it is more than likely it will be ignited, or will heat sufficiently to ignite surrounding matter. Let there be two weak spots of 500 ohms each, with a potential [illegible]

[illegible] should say that an insulation of 10,000 [illegible] ampere with the 10,000 ohms between the [illegible] of highest potential, and this quantity of [illegible]

Although I [illegible] never starting a circuit on less than 10,000 ohms, there have been occasions when the insulation dropped below that point after starting, and it has burned out at the weak point. Of course, we have no way as yet of telling when [illegible] lation drops below a certain point after the circuit has started, but I expect before long we will be provided with a device that will indicate this.

Now, to consider the cost of maintaining the standard of insulation: We see from the foregoing that 10,000 ohms is safe, so far as any danger to life or from fire is concerned, but the question arises, is that an economical insulation for us? I shall say no, but perhaps I cannot tell why any more than an engineer can explain why it is easier to keep his steam at eighty pounds than to let it fall to seventy five and then get it back to eighty. Our eighty pounds is a megohm. Let the insulation drop below that and it is hard work to get it back again. As a cause for this let us again refer to the 50-light circuit of 2,000 volts, and an insulation of



100,000, equally distributed. This gives us $100,000 \times 50 = 5,000,000$, the insulation of each space between lamps; $\frac{5000000}{2} = 2,500,000$, the resistance to be overcome by the leak or eddy current. Two lamps of forty volts each would make this leakage $\frac{80}{2500000} = 0.000032$ of an ampere, a very small quantity, but there are twenty-five groups of these leaks, the total of which is $\frac{2000}{100000} = 0.02$ of an ampere, and this 0.02 of an ampere is constantly straining to enlarge itself. With the insulation of the circuit at 10,000 we would have $10,000 \times 50 = 500,000$ ohms to each lamp space. This divided by two, gives us 250,000 as the path for the leak, and $\frac{80}{250000}$ .0003 as the quantity of current flowing through that leak, and with the twenty-five groups we have $\frac{2000}{10000} = .2$ of an ampere; quite an amount of current. With the circuit at a megohm, and following up the same computations we get but .002 of an ampere as the amount of leakage, which is so small as to be of no consequence.

From all facts, we may come to the following conclusions:

First. That if the insulation of a circuit at the lowest point is five times the e. m. f., there will be no danger to human life.

Second. That we may consider 10,000 ohms a safe insulation for a 50-light circuit, so far as any danger from fire is concerned.

Third. That we find in practice that the higher our insulation the more economical it is for us to maintain the circuits in running order, and that it is to our interest to keep the insulation as high as possible at all times.

Therefore, in establishing a standard insulation for electric light circuits, why not place it at five times the e. m. f., which, on an arc circuit of 1,000 volts, would permit of a leakage of but .2 of an ampere $\frac{1000}{5000} = .2$, and on an incandescent circuit of 220 volts [illegible] of an ampere.

Dispatch from Australia.

[illegible]

at this half-way station the [illegible] taken first, and thence sent on to Port Darwin. This, then was the first relay. The second relay [illegible] Port Darwin [illegible] and the first plunge of the telegraph beneath [illegible] to the receiving operator at Banjoewangi. This is a small town at the lowest corner of the Island of Java, one of the possessions of the Dutch. While the receiving operator was getting the message from Port Darwin the operator took what had been received, and as fast as it came in sent it out to Singapore. The cable to Singapore lies on the ocean's bed between the islands of Java, Borneo and Sumatra, and is 900 miles long. Here the message crossed the equator, and ticked across those submerged mountains, which only awhile ago were shaken in the great Java earthquake. From Singapore, the town on the extreme tip of the Malay peninsula, the lowest projection of the Asiatic continent, the story ticked its way under the waves of the Strait of Malacca around the coast of the Malay peninsula to the Island of Penang. This is a spot 160 miles in area that looks out on the Indian Ocean. The relay from Singapore to Penang was 400 miles, and then the sixth stage of the journey was begun. This was a plunge of 1,200 miles under the Indian Ocean from Penang to Madras. From Madras the next relay was by land over that part of India which projects into the Indian Ocean. The distance covered by the wires is 400 miles to Bombay on the other side of the peninsula. From there the base ball score went again under the water, this time the Arabian Sea to Aden, a distance of 1817 miles from Bombay. Aden is a seaport of Arabia, and is called the Gibraltar of the East. The message was sent from there up the Red Sea for 1,460 miles. After the message got to the end of the Red Sea it was taken by the operator at Suez. Another flashed across the desert to Alexandria. This was a lonely journey 150 miles, and here the last connection with the continents of Asia and Africa was had. On its one side were Mecca and Jerusalem and the Holy Land, on its other the ruins of Thebes, the towering Pyramids, while at the very finish of its race from Palestine and Egypt the message leaped the Nile, and passing near the Suez Canal stood on the brink of the Mediterranean, as a sort of second base on the home run from Sydney to New York. The operator at Alexandria started the dispatch out into the sea, and, traversing the bottom amid the wrecks of the navies of the Punic wars, the nineteenth century news of a base ball duel in Australia throbbed through the cable from Alexandria to Malta, 1,000 miles away, where the receiving operator turned it over to another man in the office there, and he sent it to Gibraltar. At last the story written on the shore of the Pacific had reached the coast of the Atlantic. The relay from Malta to Gibraltar was [illegible] miles, and then from there the message skipped [illegible] miles to Lisbon, then [illegible] miles to Porth Curno, then [illegible] to London, and then [illegible] miles to Waterville, on the coast of Ireland. This was a kind of third base. The runner lost no time, but jumped beneath the Atlantic, and darting 2,500 miles along, got to Canso, Nova Scotia. Here the last of the eighteen relays was made, and coming down the coast [illegible] miles, the base ball story got to New York, its home plate.

Western Electrician.

EVERY SATURDAY.

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GEORGE L. PHILLIPS, President of the Chicago Telephone company and Central Union Telephone company, and a director of the Western Electric company, died Tuesday afternoon at his residence, Edgewater, near Chicago, after a brief illness. The deceased was about 45 years of age. His wife and four daughters survive him. Another daughter recently died in New York. Mr. Phillips had been president of the Chicago Telephone company about three years, and during his administration the affairs of the company were conducted in a careful and business-like manner. The deceased was an [illegible] and enterprising business man. He was one of the original telephone men who came to [illegible] from Dayton, O., and was one of the most prominent men in telephone circles [illegible]. His death will be a severe loss to the [illegible] Telephone company, and will be mourned by electricians throughout the country.

[illegible] United States [illegible] has attracted consider [illegible]

[illegible] tantial progress is in- [illegible]

spoken for. The chairman still continues to receive letters from members of the association, in all parts of the country, which indicate that the attendance will be even larger than was at first anticipated.

THE last telephone story comes from Maine. It is related that a tramp endeavored to secure $5 from Mrs. Burleigh, wife of the governor of Maine, by telling her that Mr. Burleigh had sent for that sum. Not liking his looks she went to the telephone to communicate with the governor, and seeing the movement the tramp took to his heels. He was afterward taken into custody, and awarded his just deserts. He probably dislikes the telephone as an enemy of his craft.

THE February *Atlantic* in an article devoted to the phonograph speaks of the possibilities of a phonogram newspaper. In reference to musical criticism it says: "But think what a musical critic might be able to do for his public! He might give them whole arias from an opera or movements from a symphony, by way of proof or illustration. The very tones of an actor's or singer's voice might be reproduced in the morning notice of last night's important dramatic or musical event."

ELECTRIC train lighting continues to attract considerable attention on the part of railroad managers. A train of special Pullman cars, lighted by electricity, heated by steam, with all modern improvements, will soon make the trip from New York to San Francisco via New Orleans and the City of Mexico, returning through the north, so that a traveler can start from New York, and, while surrounded by all the comforts of a hotel, can make a complete circuit of the United States under the light of the incandescent electric lamp.

THE Chicago Electric club is still engaged in the discussion of the question of insulation. The formula adopted at a recent meeting for the determination of the necessary insulation resistance was reconsidered at the last session, and the whole subject was taken up anew. A full report of the discussion is given elsewhere. In this connection an invention which is described in this issue is of interest. It is a ten thousand volt transformer which is employed for testing resistance. It is stated that this method of testing with the transformer has given the most satisfactory results. G. E. Fish contributes an article in this number on the important question of insulation, giving the results of his practical experience.

IN an able address before the New England Electric exchange, at Boston recently, Col. E. H. Hewins reviewed the relations between the electric light and insurance companies. He said the situation demanded grave attention and energetic action. In closing his remarks he said: "The electric light companies contribute to the expense of the insurance inspection, and in return the electric interest is entitled to protection against such violations of rules as may increase the fire risk, either upon the first installation, or changes afterward. A failure to thus protect should not, in justice, be followed by increased rates, which must inevitably be an injury to electric lighting."

THE fact that the law in New York state substituting electricity for the rope in inflicting the death penalty has been subjected to considerable criticism, has not deterred other states from following in the steps of the New York legislature. The general assembly of Ohio last week passed the [illegible] bill, which provides that all criminals sentenced to capital punishment in that state shall be executed by electricity. The act is to go into effect January 1, 1890. The bill is modeled closely on the New York statute. In the [illegible] house Wiley J. Jones introduced a bill similar in all its details to the act of New York state. A [illegible] predicts its [illegible]

[illegible] New York [illegible] to the electric execution act has been referred to. Their special grievance has been that the publication of any report of an execution beyond the mere statement of fact was forbidden. A bill has just been introduced in the New York legislature increasing the number of persons who may witness the executions. The purpose of the measure is to make place for reporters. It is safe to assume that the public will obtain the news if reporters are invited, even if the clause relating to publication is not repealed.

THE London *Electrical Review*, in an article on the electric sugar swindle, says it is "one of the most astounding frauds of modern times, due entirely to 'American smartness.'" It adds, referring to an editorial which appeared in these columns, that the WESTERN ELECTRICIAN "will possibly contest the point." This is simply another illustration of the fact we have mentioned before, that our obtuse contemporary seems utterly unable to discriminate between American dishonesty and "American smartness." The electric sugar swindle is no more an illustration of American smartness than electrical quackery, which the *Review* so vigorously exposes, is an illustration of English electrical enterprise.

THOMAS D. LOCKWOOD'S interesting series of articles on "Practical Telephony" is resumed in this issue. The subject of long distance telephony is continued in the present article. Mr. Lockwood emphasizes the necessity of utilizing only the best material and appliances, and he points out that the best results can only be produced by the best workmanship. The desk set for long distance work and the circuit arrangement are illustrated and described. The article concludes with a few practical suggestions on electrical construction. To the man who is in charge of instruments Mr. Lockwood gives earnest advice. He urges him to learn how to climb poles, and clamber over roofs; to locate causes of serious trouble himself, and not to depute employes to perform the duty. These suggestions, perhaps, may be applicable to fields other than telephony.

IT will be noticed that an organization has been formed in New York to aid in the passage of a bill for the reduction of telephone rates. The reduction as contemplated in the bill before the legislature is about one-half of the present rates. In St. Louis the situation has not changed during the week. The telephone company insists that it will withdraw from the state if the measure now being considered by the legislature is adopted. In Kansas City the agitation for a reduction is still kept up. The company operating in the city has just issued its annual report, showing that the charges which it has made are by no means exorbitant.

The legislature of Michigan has followed the example set in other states. A bill has been introduced reducing very materially the telephone rates.

An item of a different character appears in the Indianapolis correspondence. It seems that the law which was passed in 1885 reducing telephone rates to $3 per month has not given as much satisfaction as was anticipated. For this reason a bill providing for the repeal of the act of 1885 has been presented. It is said to be strongly favored by business men throughout the state.

Newspapers throughout Illinois deprecate the action of O'Toole of Lake, who introduced a bill in the legislature recently to regulate telephone rates. The provisions of the bill are so manifestly unjust that there appears to be little danger that the proposed measure will become a law. The Chicago *Tribune* in a recent editorial said of the bill: "The motive of the author may be good or may be that of a sandbagger. But it would be better to leave the regulation of rates to the local authorities." It warns the advocates of this and similar bills that "a measure which bears so hard on the telephone company that the courts will not sustain it," will not advance their cause, and concludes: "As a telephone in Chicago does more work than one in Peoria, Decatur, Rockford or Joliet, let it pay more, and leave it to the administration of the several places to say what shall be just rates in each."

Practical Telephony.

By Thos. D. Lockwood

PART XVI.

The subscriber's outfit for long distance work is simply the same old organization of the same old elements which I have described in former chapters—a call-bell to receive calls; a magneto generator to send them; a telephone transmitter and receiver; a switch forming also a support for the receiving telephone when not in actual use; and a transmitter battery. But as the work is more important, and depends for its success upon the absolute perfection of the lines and instruments, there is usually more care displayed in the manufacture and assembling of these appliances than is usually manifested in an ordinary outfit. There should not be, of course; but there is. And the appliances, instead of being all mounted on a single board and screwed up to the wall, are usually supported upon an attractive appearing and convenient desk or table, which harmonizes well and without any suggestion of incongruity with the furniture of the most elegant office. The transmitter battery in this apparatus is lodged in an alcove on one side of the desk, and consists generally of several cells.

It is undoubtedly true that in all electrical instruments and circuits the greatest care is required and ought to be taken to have every

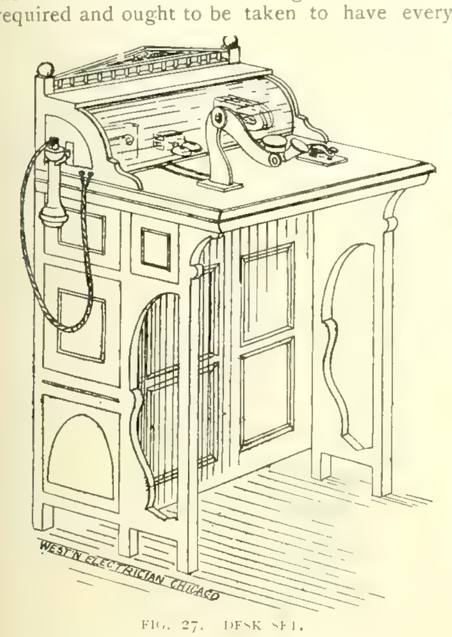

FIG. 27. DESK SET.

connection perfect; to use the purest chemicals and the best battery material; to observe cleanliness in every detail; and to avoid cheap instruments, cheap work, and cheap anything; and this is not inconsistent with true economy. If this belief has not been manifested, and if I have not made my opinion on this point clear, through all the preceding chapters, then I have written in vain; and this is more needful in all telephone work than in other utilizations of electricity, because there is in telephony nothing to spare—the current at its best is, as we all know, of the slenderest description.

Now, without departing in the slightest degree from the above articles of faith, I want to say that in long line telephony this care in the choice and use of materials and appliances; in the employment of discretion and judgment in every detail; in the necessity of electrically perfect joints or splices and connections; of using only the best battery and of keeping it the best; must, if possible, be accentuated. In short line work greater efficiency is attained by the observance of such matters; in long line work nothing can be hoped for without such observance. Thus, while I have repeated these cautions in general, I have thought well to emphasize them in this particular.

And it is necessary here to call attention to one point in the desk set, which has been spoken of. There is, of course, from its shape and material, considerable chance of change in form occurring from the expansion and contraction of wood, as the atmosphere surrounding it is dry or charged with moisture. This requires watching, or it may result in consequent alterations in the position of different parts of the apparatus with respect to one another, or to the frame itself, and deterioration in working. A case in point is in the arrangement of the generator coil. The generator is mounted in one corner where its handle is easily accessible, immediately below the surface of the desk. The generator coil is, of course, shunted, except when in the act of calling, by a short circuit arranged to be broken by the action of the crank shaft when being turned. In one form of shunt the end of the shaft rests against a stationary metallic contact piece mounted on the woodwork of the frame. I have known an instance where this woodwork so shrunk as to recede from the shaft end, and to carry the contact piece with it completely away from the shaft, thus leaving the shunt circuit entirely open; the generator coil was thus left at all times in circuit, and, this being an intermediate instrument, constantly opposed the telephonic transmission through it from the instrument beyond. This telephonic transmission was, in fact, so subdued that trouble was suspected and traced to the above cause.

A general view of one of the desk sets for long distance work is shown in Fig. 27, in which the magneto generator and bell may be seen "as through a glass darkly" at the rear of the table. They are indeed together with the transmitter induction coil, there encased behind a glass front, which adds considerably to the appearance of the desk. The telephone receiver is, of course, connected by means of the usual "appendix vermiformis," and hangs while not in use upon the switch support at one side; while the transmitter proper is mounted upon the flat surface of the desk, being supported upon an adjustable stand. It has been found that while any one is receiving it is very advantageous to short-circuit the secondary circuit of the transmitter coil, and this is done by means of a Morse key or any convenient circuit closer also mounted on the desk, and connected in an ordinarily open shunt circuit, extending from one terminal of the secondary induction coil circuit to the other. It may here be noted that, although the gain in loudness is quite pronounced, subscribers often forget after they have once pressed the key, to release it again when they themselves recommence talking, and do not recollect that they are blocking their own wheels until they find that their correspondent does not hear them.

It would hardly be proper to leave this subject without at least indicating the circuit arrangement of these desk sets. They do not differ materially from any ordinary subscriber's outfit. It will, however, be noted that the diagram, Fig. 28, indicates first that through the telephones the circuit is metallic, while through the calling appliances there is but one line which, after traversing the call-bell and generator, terminates by means of an earth-wire.

The two lines, 1 and 2, enter the subscriber's station together. That marked 1 passes to one side of the lightning arrester, thence to the point *C*, to the automatic telephone switch *S*, and there to the plate 3; thence through the switch, while the telephone is in place, to the plate 4, the bell 6, the generator *M*, and to earth at *G*. Incoming or outgoing calls follow this route. But suppose the call to have been received or sent, the subscriber now removes his telephone from its support, and the circuit is automatically changed.

Both main wires now come into requisition, and the circuit leading into the sub-station by means of the wire 1 leads out by the wire 2, and these two wires, reaching the central station, are or can be both connected with two trunk lines leading to any distant station, or with the two ends of another like circuit.

Let us now trace the two lines through the telephones by means of the diagram. Beginning as before, where the wire 1 enters, the line leads through the lightning arrester *L* to the point *C*, switch *S*, thence by way of plate 5 through the switch bar to plate 6, and then via the wire 2 through the receiving telephone *T*, secondary circuit of induction coil *I*, and the lightning arrester out.

The battery circuit for the transmitter is partly shown in broken lines, and is also con[illegible] [illegible] *I* [illegible] tery.

[illegible] in such a way as to dispense altogether with the [illegible] circuit continuous through the call-bell and generator as well as through the telephones; and it is frequently so arranged. [illegible] mode of connection is [illegible] employment only one wire need be [illegible] over, and because it is equally well adapted for use in connection with complete metallic circuit systems, or with systems in which some of the circuits are metallic, and some single wire or earth terminal circuits.

It is not supposed that every telephone man, whose regular or occasional work it is to look after telephone instruments, is or ought to be a full-fledged lineman, armed with belt, tomahawk, climbers and "come-along;" but there can be no doubt that the value of any telephone man to himself, as well as to his employer, is increased in the direct ratio of his ability to do a great many things, and to do them well; and if a good inspector is also a good wire-puller or pole-climber, and competent to perform general line-repairing work in good style, he will always be in demand. I know this because I have performed myself all of these functions, and have

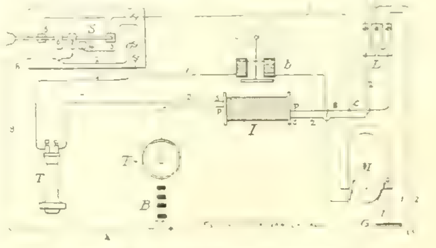

FIG. 28. CIRCUIT ARRANGEMENT.

found just how it is. And it is equally true that a lineman is more valuable in the proportion that he can do other electrical work.

For these reasons, although this is not an essay on electrical construction, I think it well to point out that a man in charge of instruments should learn to climb poles, and should not be averse to clambering over roofs, or going down cellars, after circuit troubles. In short, if you go after a trouble, whether it be in the line, or in the instruments, *find it*, and if possible, rectify it yourself. Don't let some other man have to go out and find it for you; and to do this, as I have already pointed out, first be sure of the kind of game you are hunting for. There are many points outside on the lines that it pays to give a little attention to, and which, if attended to, will prevent trouble.

The story goes that the little boy at the school exhibition stated in his essay on pins that "pins have saved the lives of many people," and that skillful cross-examination elicited the further statement that the mode of operation of this live-saving device was, to quote the little boy's own words, "by not swallowing them." So I may say that solder has made a great many bad splices or joints by not being used. Unsoldered joints ought to be watched for and always reported. Ground terminal connections should also be soldered, even though you have [illegible] yourself. Do not, however, let the fact [illegible] ground connection is soldered lead [illegible] believe that it should not require as much [illegible] as if it were not.

Look out for hook insulators which [illegible] their hollow end up. These should not be tolerated. A low line wire should also be reported at once to the proper authority, who, if rightly constituted, will thank you for looking out for him.

Cotton covered wire, paraffined or [illegible] [illegible] should not be used in passing from the outside to the inside of a building, unless [illegible]

[illegible] it is, in fact, a [illegible] for this purpose, [illegible] moisture and [illegible] the heavier insu[illegible] purpose.

I have seen subscribers' stations where the generator shunt has not been fitted with an automatic circuit breaker, and where a push button in the side of the bell-box has been re[illegible] been horrified to find that a wad of paper had not only been wedged between the circuit-breaking springs, but actually that it had been done by or with the advice of the telephone company's inspector.

I need scarcely say that this is a most pernicious practice. The introduction of the generator coil not only adds a large and needless resistance to the line which has to be worked through in sending calls, and which is likely to be destroyed by lightning in any storm, but if there should happen to be two stations on the same line, the outer one would have to talk through the generator coil of the intermediate one, and the conversation would be much cut down in volume, and also, in some measure, marred in articulation by the counter currents developed in opposition to the talking currents by the passage of the latter through the armature coil.

(To be continued.)

Chicago Electric Club.

The regular meeting of the Chicago Electric club was [illegible] January 21st. C. C. Haskins presided. After the transaction of routine business the discussion of the question of insulation was resumed. At the [illegible] meeting the formula $\frac{E \times 1,000}{L}$, proposed by F. B. Badt for the determination of insulation resistance in arc systems, was adopted as a standard formula by which insulation could be determined in all cases. This action was [illegible] in order that the matter might be again brought b.fore the club.

Mr. B[illegible]: In reading the proceedings of the last meeting I [illegible] that Mr. Sperry especially, as well as Mr. Leonard, made the point that the element of length was not [illegible] in that first formula which I proposed—$\frac{E \times K}{C}$. In order to [illegible] the discussion I think it will be wise, instead of adopting a certain figure for the constant, simply to express it by K, then, in the second discussion, determine the size of that constant K. Let us decide upon the formula now and later on we can determine the constant. Two points were made—that more than one formula would be two complicated, and that the second formula—$\frac{E \times 1,000}{L}$—was better, as the element of length was included in it. I want to show that the element of length is in the formula $\frac{E \times K}{C}$; it does not show, but it is there just the same. Let us consider the second formula as it was adopted last meeting for incandescent insulations. Length was defined, as I understand the proceedings, as the number of incandescent lamps multiplied by a certain average length of wire. The Rookery building, I think, [illegible] with about 100 feet of wire for [illegible] lamp. So this factor L was practically defined as N multiplied by a constant; N signified the number of lamps and K was a constant; the latter was to [illegible] by the city inspector, introducing in this formula another constant; in fact, a constant which is unknown, and which may vary in each installation. Now, if we substitute this expression for L, L being N or the number of lamps multiplied by the constant in this formula, [illegible] $\frac{E \times K}{N \times K2}$. If we adopt [illegible] constants we can cancel one [illegible] and we can read that formula [illegible] the number of lamps represe[illegible] Each lamp has a certain [illegible] multiply N [illegible] current in amperes [illegible] formula which I have developed from [illegible] very [illegible] current [illegible] [illegible]

advise the adoption of this first formula, $R = \frac{E \times K}{C}$.

Then let us determine the constant, and, in order to apply this formula for arc light circuits, let us ascertain for how many miles, or for how many thousand feet, that formula shall stand. If it stands for a two-mile circuit we would divide it by two, and for a ten-mile circuit we would divide it by ten, and so on.

Mr. W[illegible]: I w[illegible] Mr. Badt what he is going to call his C, whether he is going to take it for the total capacity of the mains, or just what he reads from the ampere meters. If he is going to take the total capacity of the mains we must instruct the inspector what C is just as we must instruct him what the circuit length is. If he is going to take it for what he reads upon the ampere meters we are not going to get what we want. If we have a large installation we make the length of circuits of wire up for a large number of lights that we hope to put on at some future time.

Mr. Badt: That question can be very easily solved. There is a law in Chicago to pay for the exact number of lights. If you pay your inspection fee for 50,000 lights, that fee stands for 50,000 multiplied by the fraction of ampere which each light uses. As long as you have only 2,500 lights, that is your factor. It could be objected, of course, that the whole wiring system was laid out for 50,000 lights, while you have only 2,500 lights burning; but how is the general practice? All the little branches are certainly not connected up, except there are actually lights running on them. If not used, they are disconnected. In doing that you would reduce the area of your wiring system considerably. You would find that in practice the definition of C would work all right. Of course, as far as mains and feeders are concerned, which were laid out in the first place, it would seem a little unjust, and probably a little allowance could be made. These laws will only be a guide to the inspector, and the inspector must have some discretionary power to allow a little more than the law provides for in such a case. There never was a law made which was perfectly just in all cases, and I do not suppose we can make one which will be; but we can make one which will be much more just than the one we now have.

Mr. Thompson: I am still of the opinion that it is better to have one formula for arc light work and one for incandescent work than to use one formula for both, or perhaps it might be well to have one for low tension currents and one for high tension currents. I also think that the formula which was adopted at the last meeting really covers the ground better than that which has C in it. We can take an example, which I think will show wherein C would not be a true measure of insulation. Take a long arc light circuit of, say, 5,000 volts potential. It may have on it ten lamps, and may be two or three miles long perhaps, with the lamps bunched at the other end. Take another case, such as a long block; these ten lamps might all be within the length of that block. There is one thing that I think is very clear to every one here, that the leakage along that three mile circuit will be far greater than it will along the 500 foot circuit, and yet in each case the quantity of current is the same. In arc lighting the variable is E, and in incandescent lighting the variable is C. I agree with Mr. Badt in that L in the second formula simply brings in C, as he has shown us. That is, it really comes down to $\frac{E \times K}{N}$ in which N, of course, is equal to C. I think that for general use the second formula is perhaps preferable. I do not think it is fair to the arc light people on long circuits to expect them to maintain the same insulation resistance, that they have on a very short circuit, and to measure a quantity on the ampere meter that is constant, no matter what the length of the circuit is, or that varies within a very small amount. I am still of the opinion that $\frac{E \times K}{C}$ is the best formula for incandescent work, and that $\frac{E \times K}{L}$ is the best formula for arc light work, for the reason that L can be determined for incandescent work by using another constant, and thatthere is more reason in the second formula as a general formula than there is in the first. The formula contains those factors E and L upon which the insulation resistance depends. It does not depend upon C. Therefore, I think if one formula is to be used, the second one is preferableon the ground that it is logical, if nothing else. The first, I think, lacks that one point.

Mr. Badt: I would propose another thing to make the formula still neater. Let us combine the two. $R = \frac{E \times K}{C \times L}$.

I was figuring yesterday how that formula that I proposed for arc lighting would work for what we call low tension and high tension arc lighting, for a system using 15 amperes and say about 25 volts per lamp and a system using about 10 amperes and 45 volts per lamp. In figuring out the different conditions of the two systems, I found that with a given number of lamps in order to lose the same percentage of energy in the wire it was necessary to put for the low tension system 2¼ times the amount of copper, or money [illegible] tension. A low tension [illegible] of course a great disadvantage, the high [illegible] about 2¼ times cheaper so far as the [illegible]. In figuring for the insulation, [illegible] be better for the high tension system [illegible] low tension system, the ratio, of course, [illegible]. I found that the high tension system [illegible] higher insulation resistance. So [illegible] the high tension system [illegible] insulation.

[illegible] using the high tension [illegible] for a given [illegible] to adopt a for[illegible] light formula. That [illegible] the low tension, [illegible] 2¼ times [illegible] high tension system

[illegible] tension system [illegible] I think should be required. As far as incandescent lighting is concerned, you can very easily see that, besides introducing C, which unquestionably should be there, you see [illegible] I demonstrated before, is C again multiplied by another constant, which, it seems to me, should be varied according to circumstances. What I want first is, [illegible] to determine on a certain formula, and then let us determine what we want for K and what we want for L, and I think a formula of that description could be applied to all cases, and to all cases justly, while a formula with simply L in that indefinite manner, as expressed in the second formula, and applied to all cases, would not be just.

Mr. Thompson: Mr. Acheson in his paper before the Electric Light association, Sept. [illegible] gives a formula for measuring the disrupting discharge in a cable. The formula he gives is $\frac{(e.\ m.\ f.)\ [illegible] \times capacity}{d} = d$, which is equal to the distance that a spark will jump. The a is the quantity determined for different kinds of insulation. He gives paraffine and cotton in which a has the value of 5,882. In working it out for a cable where E, electromotive force, is 1,400 volts, he gets the length of the disruptive spark as 94 ten thousandths of an inch. The high tension needs the higher insulation, but even with that enormous electromotive force of 1,400 volts, paraffine and cotton, the striking distance between the wire cylinder and the weakest point, supposing the outside to consist of a lead covering, is a very small fraction of an inch, and the insulation is several times thicker than that, so that in any one case that question of insulation comes in only to show that a high tension current needs better insulation than a low tension current. I still think that two formulæ are better than one, but if we must confine ourselves to one the second formulæ is logical. Ten miles of wire will only have one-tenth the insulation resistance of one mile, no matter whether you have a current of one one-thousandth of an ampere, or 1,000 amperes.

Mr. Ferguson: I agree with Mr Thompson that in considering any formula for insulation resistance we ought to adopt one which contains as factors only those elements upon which insulation resistance depends. As he said, it depends only upon the length. The tendency to break down the insulation depends entirely upon the electromotive force, and the factor C is entirely foreign to the subject. The only value of C is that it gives a rough indication of the length of the line. As we adopted the second formula of Mr. Badt the value of L was in units of miles, and as I understand Mr. Leonard's remarks, he simply said that fi ty feet times the number of lamps gave a rough indication of the length, but he did not give that as the method of determining the length. The length had to be taken at its actual length. If we take the length in miles, it seems to me that no man can very easily make a mistake of a mile, in estimating the distance, if he has had any experience at all in electric lighting, and I think we ought to adopt the formula that contains only those elements, upon which insulation resistance depends. If we adopt C, it might look to outsiders as though we thought the insulation resistance varied inversely as the current. I think the formulæ $\frac{E \times 1,000}{L}$, in which L is the length in miles, should be adopted.

Mr. Badt: I agree with the gentleman fully in regard to the theory of that formula. The element C is of no consequence whatever, as far as the insulation resistance is concerned; and I think in our first meeting on that subject, we made that perfectly clear. But we must get up a formula which is not only theoretically correct, or nearly so, but a formula which will contain the elements which we can practically determine, when we want to measure the insulation resistance of a plant. While C can easily be determined, and C simply represents the current in amperes, it is very difficult to determine the length of wire in an incandescent system, and I am afraid that it will simply be guessed at, or that the company who put the installation in will simply say, "Well, there are so many feet in it." You can very easily see that they would have it in their power to make the insulation resistance all right. They measure it and then find out how many feet of wire per lamp are necessary to get the insulation resistance up to the standard. There is one circumstance, however, where C cuts a little figure. C is not only a crude estimate of the length of the wire, but it is also a crude estimate of the thickness of the wire, and the larger C the more surface of insulation will be exposed, and so I think C after all is not so bad as it looks.

Mr. Thompson: I only wish Mr. Badt had been here the other night. I think he might have helped me a little in my fight for the adoption of two formulæ. I agree with Mr. Badt that C in the first formula he gives represents in a certain way, L; and that C, as he also says, could be very readily determined from the ampere meter, while in the arc circuits the length can be very easily determined. I also think that there may be some difficulty about the length of incandescent circuits, so it will be but little better than guesswork, particularly in large buildings. This formula is going outside, and perhaps they may not understand it, and if we are going to have but one formula, let us keep in it the proper factors.

Mr. Ferguson: I do not at all believe in having two formulæ. I think that one is a great deal better. As far as determining the length is concerned, I do not think it is easier to determine the length of an arc light circuit, than of an incandescent circuit, because an arc circuit runs around under sidewalks and other obscure places, and you cannot tell just where it is running by simply looking at it. In the incandescent plant you can go in and see the whole thing in the building, and get at the length of it. Again, in that formula, if the distance is anything less than a mile, it is taken as a mile, and it seems to me there is no difficulty whatever in determining the length, with miles or units.

Mr. Badt: I do not believe, if we asked every one

present, whether he would prefer to find out the length of an arc light circuit, or the length of an incandescent circuit; he would choose the latter. I cannot see how it could be easier to get at the number of feet in an incandescent circuit than in an arc light circuit. The arc light circuit is generally laid out on a map of the town, and there are very few lines in it which you could not follow with a rule and find out within half a mile or so how long an arc light circuit is. I have been doing that with the arc light circuits that the city of Chicago put in. I went over them with a rule, and I believe I know within a quarter of a mile how long each of these circuits is. Besides, you can get at the resistance of the circuits in another way; you can take your bridge and measure the resistance of the circuit with the lamps cut out, and that will give you a very fair idea of the length of the circuit, providing your joints are good, and they ought to be good, while in the incandescent circuit neither of these means will give you any result at all.

Mr. Ferguson: I would not have Mr. Badt understand that I think it is easier to determine the length of an incandescent plant in feet than it is an arc light circuit in feet. I mean in miles, as the formula was adopted. I claim that a man can estimate the length of an incandescent plant in miles as easily as he can an arc light plant in miles. Again, taking that formula with C in it for an arc light system, it does not cover the case at all. You have the value of C there as a constant arc, it has no place whatever in considering the insulation resistance. The only factor in the formula $\frac{E \times K}{C}$ for arc light plants that indicates length, is E. E more or less indicates length in the arc light system. But still it is not exact, because the lamps may be bunched together, or may be distributed over a large area, and I fail to see why the element length should not be indicated Again, if we were to adopt that formula on the blackboard, we have two complications. We have one complication in length, and the unnecessary factor of C.

Mr. Badt: I will say C, in a formula of that kind, is not new by any means. It has been proposed time and time again in France, as well as in England, by electricians of some standing. It is not new, and I never claimed anything original about my formula. On the contrary, I said that I thought that matter over very carefully, and had studied the material given in the French and English journals, and I came to these conclusions, but I do not claim any originality whatever.

The club adjourned to February 4th, for the further discussion of the question. It was voted that the final vote on the formula be made a special order for February 11th.

New York Board of Electrical Control.

The following extract is taken from a recent report of Dr. Wheeler, expert of the New York Board of Electrical Control:

The first arc lights operated by underground conductors in New York have been started by the Harlem Electric Light company, and are now running successfully. The conductors connecting these lights are Bishop's gutta percha covered cables, such as could be found readily in the market, and are single conductor cables, according to the recommendation of the board. They are laid in the Johnston conduits on One Hundred and Twenty-fifth street, from Third to Lexington avenues, and are connected with the station by overhead wires of the ordinary kind. The overhead wires are connected to the cables at the top of the lamp post, and the cables are carried down the lamp post, under the curbstone, and into the conduit through an ordinary iron pipe set in the post. The house connections are made through iron pipes running from the conduit under the sidewalk and up the front of the building in an inconspicuous place. The tests of the underground cable and of the overhead connections showed very high insulat on, and the whole is working very satisfactorily, and poles down.

The eight-conductor cable laid for the Brush company on Broadway, from Fourteenth to Thirty-fifth streets, has been tested, and the insulation of the joints very much improved. This cable, which had an insulation of itself very much in excess of the standard required, was found to have a lower insulation when connected up, in consequence of slight moisture reaching the joints before they were covered up during the rainy weather. This has been overcome by simply warming and drying the joints, and now it has an insulation of 50 megohms for the entire length of one mile; and while the company having the matter in charge propose to carry the improvement still further, the cable is already in extremely good condition, and perfectly suitable for carrying high pressure currents. In fact, such currents could now be put on the cable with perfect safety, even if it had only one-quarter of its present insulation, notwithstanding statements made by the press that it is a failure. The subject of explosive, illuminating and other gases entering the subways from the surrounding earth has received considerable attention, and a number of good plans for remedying the difficulty have been suggested It is suggested to keep the air filling the conduits at a slight pressure in excess of the external pressure by means of small blowers applied at one or more points of the system. The purpose of this is to change the direction of the slow leakage of gas through the walls of the manholes So that instead of gases gradually coming through from the surrounding earth the air will slowly escape from ths manholes into the earth, or else hold the gases in check. It is thought that a very slight pressure of perhaps a quarter of a pound to the square inch, similar to the pressure of gas in the gas mains, which is inexpensive to maintain, will be sufficient for this purpose. When a manhole is opened for making connections, the circulation of the air through the connecting tubes to other manholes will be so slow that it will not seriously reduce the pressure of the system, particularly if all but one or two of the tubes are plugged Another plan which has been suggested is to fill the entire system of subways with carbonic acid gas, the material which is used in portable fire extinguishers. [illegible] that it will effectively prevent [illegible] will prevent the [illegible] fire, and [illegible] in fact, extinguish any [illegible] known.

Lamp Lighting Schedule. — Moonlight System.

FEBRUARY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H. M.	H. M.	H. M.
1	**6 00**	6.10	12.10
2	**7 00**	6.10	11.10
3	**8.10**	6.10	10.00
4	**9.10**	6.10	9.00
5	**10.10**	6.10	8.00
6	**11.10**	6.00	6.50
7	12.10	6.00	5.50
8	1.00	6.00	5.00
9	2.00	6.00	4.00
10	3.00	6.00	3.00
11	3.50	6.00	2.10
12	4.30	6.00	1.30
13	No	light.	0.00
14	No	light.	0.00
15	No	light.	0.00
16	**6.00**	**7 30**	1.30
17	**6.10**	**8 40**	2.30
18	**6.10**	**9.40**	3.30
19	**6 10**	**10.50**	4.40
20	**6.10**	**12.00**	5.50
21	**6.10**	1.10	7.00
22	**6 10**	2.20	8.10
23	**6.10**	3.30	9.20
24	**6 10**	4.30	10.20
25	**6.20**	5.30	11.10
26	**6 20**	5.40	11.20
27	**6.20**	5.40	11.20
28	**6 20**	5 30	11.10
Total number of hours,			170 30

The foregoing schedule is practically good for the United States

The time for commencing to light is calculated at one half hour after sunset, or one hour before moonset, the time for extinguishment one hour after moonrise, or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock midnight is shown by bold face type, after midnight by light face type

CORRESPONDENCE.

New York Notes.

New York, Jan. 25.—It is announced that an agreement has been made between the Westinghouse Electric company and the United States Electric Lighting company whereby the interests of the two companies shall hereafter be conducted for mutual benefit, both in the manufacture and sale of electric apparatus, and in the management and litigation of their patents. The United States company is one of the oldest electrical manufacturing companies, and has a large and growing business in arc and incandescent lighting, and plating apparatus, motors, and alternating current apparatus, a large factory in Newark, N. J., and many electric light and power plants in use. It holds many strong patents, some of which are fundamental, its inventors having been the earliest in the field of practical electric lighting and transmission of power. The new combination has a manufacturing capacity of over 15,000 lamps a day, and the two companies own and control about 700 patents on electrical inventions, which they propose to litigate actively for joint benefit. The combination represents a united capital of about $1,000,000. It is understood that the Bate decision, relating to foreign patents, is regarded by these companies to be greatly to their advantage in strengthening their own position as well as that of patents in general.

A meeting of the telephone subscribers who favor the bill prepared by the Board of Trade and Transportation and introduced in the legislature by Robert Ray Hamilton, providing for the reduction of telephone charges, will be held at the rooms of the board, in the Bryant building, tomorrow afternoon at 1 30 o'clock. For New York and Brooklyn the proposed reduction is from $12.50 and $15 to $6 per month It is claimed by the board that the Metropolitan Telephone & Telegraph company's average net earnings per subscriber for 1887 were $94.11; for 1886, $80.96, and for 1885, $115.14, while the company, in the last two years, put a large sum of money into its new building in Cortlandt street, thus apparently reducing its net earnings from about $130 to the figures given.

Mr. Linson has introduced in the Senate an amendment to the laws relating to the infliction of the death penalty It allows to be present at public executions, besides the persons provided for in the original measure, twelve others, to be selected by the warden of the prison in which the condemned man is confined. This grants admission to [illegible]

[illegible] have arisen, and are daily growing to intolerable proportions [illegible] public and inventors the good which they should derive."

The Board of Electrical Control had an important session on the 18th at the mayor's office. On the resignation of Mr Hess, the mayor was elected to the presidency of the board. The United States Illuminating company offered to lay down an experimental cable in the subway, and the proposition was gladly assented to by the board.

There has been a succession of more or less serious accidents from electrical wires during the past week, and the papers are now clamoring for the placing of the wires underground. P.

St. Louis, Mo.

St. Louis, Mo., Jan. 27.—A prominent member of the Bell Telephone company said yesterday: "We cannot operate the exchange for less than $80 a year, as we were willing to prove by our books. We are willing to have a competent committee of merchants go to Jefferson City, and testify as to the facts of the case. We must have allowances for wear and tear, and loss through lapse of patent. And a 10 per cent. return on a patent-right is surely small enough. If the rate is reduced, the Bell Telephone company will withdraw from St. Louis "

At a meeting of the Electrical society last week Prof. Short of the Short system of electrical railroads, was present, and discussed the matter of electrical railroads. He was confident that the multiple or parallel system would soon be dispensed with. He also explained that in eastern cities where the multiple system was used and the circuit grounded through the rail, the current flowed in various directions, but generally in the path of least resistance to some other wire that was grounded and caused trouble.

The bill of specification for illuminating the city by electricity is now in the hands of City Councillor Bell. Both the deposit and bond required are the maximum allowed by law—$5,000 for the deposit, and $10,000 for the bond. The term of contract named is ten years.

The first ball of the Bell Telephone employes was given on January 17th, at Natatorium Hall, and proved a success. By 9 o'clock there were nearly 1,000 people in the hall, which was profusely decorated for the occasion. N.

St. Louis, Mo., Jan. 25.—The municipal assembly to-night granted the National Subway company of Chicago a franchise to construct electrical subways in the streets of this city, to carry all telegraph, telephone and other electric wires. The work of construction will begin inside of sixty days, and in a year from now it is expected that all the wires in St. Louis will be under ground. A bill is now before the State legislature providing that all wires shall go under ground. McD.

Indianapolis, Ind.

Indianapolis, Jan. 27.—The residents of Irvington, three miles east of this city, have been endeavoring to induce the railroads to give them better service between there and the city, but without effect, and are now looking into the matter of an electric railroad. It is understood a Terre Haute company is looking after the matter

The local Brush Electric Light company have nearly all their lamps in position, and last night, for the first time, lighted those which were ready While the lamps are so far apart did not light the streets as well as was expected, they were a great improvement on gas lamps formerly used. Mr Caven, president of the company, says they have gone to greater expense than was at first expected. The understanding was at first to light the business portion of the city only. In doing this, the 100 lights contracted for could have been put in and connected by the use of ten miles of wire where in covering the routes selected by the council committee on light, they have been compelled [illegible]

[illegible] high-priced, as [illegible] and they had to use a superior quality of insulation. The plant now consists of four [illegible] 25 lights. These are operated by an Atlas-Corliss engine of 150 horse power [illegible] three 100 horse power and one 80 horse power boilers. Considerable trouble has been experienced in putting up masts and light arms so as to clear telegraph and telephone wires. The arms are of the Indianapolis Jenney company's patent.

A bill has been introduced in the legislature repealing the telephone law of 1885, in which the monthly charge was limited to $3. Another has been introduced regulating the taxing of telegraph companies. M.

Kansas City, Mo.

KANSAS CITY, Mo., Jan. 26.—At the annual meeting of the Missouri & Kansas Telephone company in this city last week, the following directors were elected: James Chick, W. B. Clarke, C. D. Crandall, Kansas City; J. R. Mulvane, T. B. Sweet, Topeka; John A. Hudson, Boston; Geo. L. Phillips, Chicago; James T. Lam, Davenport, Ia., S. A. Walker, St. Joseph. The board immediately organized and elected the following officers: John R. Mulvane, president; C. D. Crandall, secretary and treasurer. A dividend of .5 per cent. for the last quarter was declared, although President Mulvane stated the financial condition of the company did not justify such action. The net number of new subscribers last year was 279. In President Mulvane's annual report appear the following figures: Gross earnings, $394,507.41; gross expenses, $316,894.85; net earnings, $77,612.56; dividends, $54,475.50; loss of December 25th–26th, $20,000; balance, $23,137.06.

Only 4½ per cent. on capital stock was paid in dividends during the last year. Heretofore 6 per cent. has been paid. The increase in the gross earnings for the last year was $44,974.94, but there was an increase in the expenses which made the net earnings of last year $12,251.36 less than the previous year. The report closes with an earnest plea for proper consideration. Attention is called to the excellent service given the subscribers, and the enormous expense attached to the maintenance of the exchange. Furthermore, the company has built at its own expense a city police and fire alarm service, and has maintained this without expense to the city. This of itself is an item of no little consequence. R.

New Orleans, La.

NEW ORLEANS, La., Jan. 25.—The Knights of Electra will appear on the evening of February 28th, in an electric pageant. They will present an ingeniously devised travesty of a local theme, in which the electrical equipment will play an important part. Five hundred tinkling electric bells and 500 sonorous buzzers will be dispersed throughout the line. Myriads of miniature and large incandescent lamps of various tints will change shades continuously in rythm with the music along the line as the pagaent moves.

Ingenious electrical novelties designed especially for this occasion will appear in the pagaent. Each knight on the dynamo circuit will be converted temporarily into a patent shocking automaton of very low voltage. The current will be generated by fluid and storage cells and [illegible] plants moving in the column. This pagaent will be a moving exposition of electricity. S.

Louisville, Ky.

LOUISVILLE, Ky., Jan. 25.—The Louisville and Nashville railroad has just decided to use electric semaphore signals [illegible] 3,000 miles.

[illegible] has now been adopted by [illegible] steamer entering the [illegible] since the [illegible]

[illegible]

Some of the enterprising citizens of Glasgow are investigating the electric light system with a view to adopting that method of street illumination.

The new electric light company at Paducah promises to have its plant in operation within sixty days. The delay, it is explained, was caused by the burning of the Jenney manufactory at Fort Wayne. Two experienced electricians from the Westinghouse Electric Light company, Pittsburgh, will arrive in the early part of next week to put in the incandescent plant for the Gas company. The wires are now being erected.

C. A. Knight of Chicago was in Owensboro last week, and promised to commence within a few days the erection of the new electric light plant. M.

Galveston, Tex.

GALVESTON, Tex., Jan. 25.—The special committee of the city council, appointed to solicit bids for lighting the city for five years after the expiration of the present contract with the Galveston gas and electric light companies, met recently and opened proposals. The price now paid for public light is about $20,000 per annum. An arrangement has been made by which the plant can be located and run in connection with the new waterworks system: Galveston Gas company—gas for street lamps, not less than 200 lamps, $24 per annum per lamp, including lighting, cleaning and repairing; for public buildings, $2.25 per 1,000 feet. Miller & Tyson, Wilson, N. C., propose to establish and equip an electric light plant of the Waterhouse system, with 1,700 candle power lamps, for $42,408.81. The Edison Electric Light company, New York, proposes to furnish an Edison plant with a dynamo capacity of 1,200 lights of 20 candle power each, and wire the streets with insulated wire for 1,000 lights, for the sum of $27,000.

The Brush Electric Light company of Galveston proposed to furnish arc lights of 2,000 candle power, distributed as the city may select, run on the moonlight schedule at $120 per light per annum, or run all night for $130 per annum; incandescent lights to be located as the city may direct; 16 c ndle power, moonlight schedule $24 per light, all night $26; 25 candle power on moonlight schedule $28 per light per annum, all night $30, and to light all public buildings and offices with 16 candle power lamps at 1 cent per lamp per hour.

Frank S. Marr, electric light contractor, Pittsburgh, Pa., has three different propositions to furnish lights from their own plant. Another proposition from Mr. Marr is to furnish an electric light plant to the city for $44,474. Another bid of Mr. Marr is to furnish a plant for $47,973.24.

David Hall of Galveston, representing the Western Electric company of Chicago, proposes to furnish a complete plant of a capacity of 200 arc lights of 2,000 candle power each, including two high speed engines of 125 horse power each, the entire plant to become immediately the property of the city upon their agreement to pay $1,240 a month for a period of sixty consecutive months, or $1,364 for forty-eight months, or $1,556 per month for a period of thirty-six months. The payment named to cover the entire cost of the plant, and the expense of maintenance and operation.

At the last meeting of the East Dallas, Tex., council Mr. Ganzer of the special committee appointed to ascertain the cost of lighting the streets with electric lights, reported that the Queen City Electric Light company would put up a number of lights, like those in Dallas, at $96.60 each per annum, estimating that at least twenty lights would be needed. The report was received and referred to a committee to confer with the electric light company named, and also a company about to begin business, and report at the next meeting. R.

Springfield, Mo.

SPRINGFIELD, Mo., Jan. 25.—The St. Louis Power company, agents of the Sprague Electric Motor & Railway company, has put in a bid for the purchase of the entire street railway system of the city. The transaction, if the deal is made, will cause a transfer of some $500,000 from the motor company to the Springfield stockholders. F. B. Smith, the local superintendent, states, however, that they will not sell out, but propose to abandon the horse car lines altogether and put in electricity. The building of the electric road [illegible] granted a franchise, is an assured fact, and a certified check for $[illegible] has been put up by Mr. [illegible] in compliance with the ordinance. Messrs. Lawrence and [illegible] of Kansas City were in the city last week for the purpose of securing a location for the power house [illegible]. One of the locations which [illegible] the present electric motor building on [illegible] are now negotiating. Mr. [illegible] of the material for the new road [illegible] track by March 15th, [illegible] operation they state by June 1. H.

Pittsburgh, Pa.

PITTSBURGH, Pa., Jan. 25.—The boroughs of Wilkinsburg and Edgewood have emulated Pittsburgh's example, and decided to have their streets lighted by the East End Electric company.

Speaking of the progress made in the lighting of the lower part of the city, Mr. Rowland said: "We are going ahead as fast as we can, and the lights in the lower part of Pittsburgh will be soon in operation. We are now commencing to put up the wire. All the wire used here will be No. 6 lead copper wire. According to a calculation which I have just completed, the lower part of the city, from the Point to Grant and Eleventh streets, and all along the streets in the section called the Old City, will take 100,000 feet of electric light wire to supply the lamps put up, or about 21 miles. How many miles of wire we will use altogether I am not able yet to say; but we are ordering it in quantities of 100 miles each, and how often we shall have to do that I cannot yet say. Let me tell you again, that I mean Pittsburgh to be the best lighted city in the world, and I will give one of the best proofs of that right here. The citizens of East Liverpool have sent me this letter, asking me to bid for a contract to light their town; but I will not do it, because all the electric power and facilities we have at present shall be used in this city. When we have done that successfully, we will take other contracts but not before." G.

Newport, Ky.

NEWPORT, Ky., Jan. 26.—Mayor Berry, under instructions of the city council, which body declared the electric light poles erected on the streets several days ago by the Newport Light company a nuisance, recently at an early hour had a force of men out and removed the poles at several streets, cutting the wires and wrapping them around those poles left standing. Capt. John A. Williamson, president of the company, immediately put a stop to the proceedings by filing an injunction suit in the Chancery court against the city, Mayor Berry and others, enjoining and restraining them from in any way interfering with the plaintiff from furnishing light and re-erecting those poles torn down, and for $5,000 damages for the tearing down of poles. After the service of the injunction Captain Williamson started his men to work re-erecting the poles taken down. About 5 o'clock the city also filed an injunction suit against the Newport Light company and its president, Captain Williamson, perpetually enjoining said company or its agents from continuing any and all such poles and wires, and from the erecting any more poles or stretching any more wires on the streets. The injunction was served on Captain Williamson. As the Chancery court is now in session, the matter will be heard at this term. It is said the whole matter will be thrown into the United States court, and there settled for good. N.

Cincinnati, O.

CINCINNATI, O., Jan. 25.—On 'Change recently there was considerable discussion regarding the action of the two telegraph companies, the Western Union and United Lines, in refusing to enter into a new lease with the Chamber of Commerce, because the board of directors of that body had decided to exact rent from the telegraph companies should they occupy space in the new building. A great many of the brokers and provision merchants were of the opinion that the telegraph companies had acted unwisely, and while they admitted that they would be greatly inconvenienced by the refusal of the telegraph lines to occupy the building, yet they believed the chamber was taxed now pretty high for the privileges given them in the matter of market quotations. In the grain corner the opinion prevailed that the telegraph companies, the same as any one else doing business on the floor, should be taxed for the privilege.

At a meeting of council at Hamilton last week it was resolved not to renew the contract with the Hamilton Gas company, the contract having expired. The city clerk was also directed to notify the Gas company that the city does not wish to continue lighting the streets and public buildings with gas. The Gas company has had a contract with the city of Hamilton since 1855, but for some time there has been trouble over the quality of gas furnished. It is probable that electric light will be substituted. H.

Anniston, Ala.

ANNISTON, Ala., Jan. 25.—W. C. M. Ryan, superintendent of the telephone exchange at this place, has left for parts unknown. It is said he is short some $500. Fast living and reckless extravagance is said to have been the cause of the shortage. Ryan is well known in Birmingham, having been connected with the telephone exchange there for some months. This is the third superintendent of the telephone exchange here who has been short in his accounts. L.

THE ELECTRIC LIGHT.

The Elgin, Ill, city council has postponed until February 7th action on awarding the contract for the city electric light plant.

The Western Electric company, Chicago, has been awarded a contract for a 100 light arc plant for Chihuahua, Mexico. The city will operate the plant.

The Excelsior Electric company has been awarded the contract for supplying a 40-arc light plant for South Evanston, Ill. The plant is to be operated by the town.

The People's Electric Light company of Chicago, Ill., has been incorporated with a capital stock of $20,000. John J. Curran, W. A. Leary and James F. Scanlan are the incorporators.

The Thomson-Houston company, Chicago, reports these recent sales: Wabasha, Minn., 300 lamps, incandescent; Austin, Minn, 500 lamps, incandescent alternating system; Chicago, Ill., Rubber company, 200 lamps, incandescent.

The Van Depoele Electric company is installing an 800 light incandescent plant for the People's Electric Light company at Streator, Ill. A force of men is now engaged in putting up the circuits. The company has let the contract for a new central station.

The Sheffield, Ala., Electric Light company has awarded a contract to the D. A. Tompkins company, Charlotte, N. C., for a 750 light Westinghouse alternating dynamo, 75 horse power Westinghouse engine, 90 horse power boiler, which will increase its capacity to 1,500 16-candle power lamps.

R. C. Garhart, representing the Westinghouse company, is endeavoring to organize a company in Rochester, N. Y., to introduce the Westinghouse system. Many capitalists of that city are interested in the movement, and it is expected that a plant will be in operation in about three or four months.

The Van Depoele Electric company is installing a central station incandescent plant at 234 Broadway, New York. E. E. Britton, the eastern manager of the company, will have charge of the plant. The station will begin with 800 lights, and the capacity will be increased as business warrants.

Among the recent installations of Leonard & Izard, Chicago, are the following: Marinette Iron company, Marinette, Wis., 160 light incandescent plant; Dick Bros. Milling company, Quincy, Ill., 60 light incandescent plant; Antigo, Wis., central station, increase which will double its present plant of about 500 lights.

The Van Depoele Electric company, Chicago, has received orders for the following plants: Bessemer Electric Light & Power company, Bessemer, Ala, 100 arc lights and 500 incandescent lights for central station lighting; Washburn Milling company, Minneapolis, Minn., 100 light incandescent plant, to be installed in Wakefield, Mich.

Mayor Oliver of Lockport, N. Y., is opposed to the local gas company, which also controls the electric light plant. At a recent public meeting he advocated the purchase by the city of its own plant, saying that when the gas company charged $135 per light the city could receive the same service for $50 per lamp. A committee was appointed to visit cities owning their own electric light plants to examine the operations of the same.

The Standard Underground Cable company of Pittsburgh, has secured a contract from the Electric Wire Construction company of Rio Janeiro, Brazil, to furnish 180,000 feet of underground wire. The Westinghouse Electric Light company also has the contract for lighting the city, and it is in connection with the plant already established in the South American metropolis, that the cable is to be laid. This is the largest order of cable ever sent into South America. The entire city of Rio Janeiro is to be lighted by electricity, and every foot of wire is to be underground.

The plans for lighting St. Louis by electricity, now before the mayor, provide that arc lamps be placed at alternate intersecting streets, or two blocks apart, so that each lamp shall have a field of one block in each direction. For blocks of over 400 feet in length, and under 800 feet in length lamps are to be put at each intersecting street. When the blocks are over 800 feet in length the lamps will be put as near 800 feet apart as possible. On the more unfrequented suburban roads the lamps are to be put 1,000 feet apart. In case the municipal assembly sees fit to have the alleys lighted, incandescent lamps of thirty-five candle power each will be placed near the middle of the block in the alley.

The London *Electrical Engineer* pays a tribute to the enterprise of American electricians, who, according to that paper, close a contract and establish a plant in less time than it requires a slow-going Englishman to make up his mind whether or not he desires electricity. The article says: In the States it is a common occurrence for orders to be received and executed for a central station to be running within a fortnight after receipt of order. What would be thought in England if we announced one week that some town, say Warwick, had ordered a public central lighting plant, and that in the next week's issue we gave full description of the successful start of the station? We need not attempt to be quite so quick as this, but where is the need for all the usual delay and deliberation on the part of our town and municipal authorities?

When incandescent lighting was introduced into Rochester, N. Y., the Edison company secured a contract for lighting the county buildings. The superiority of the new light was evident, the cost was less than that of former years when gas was used, but the country members of the board of supervisors were suspicious—the only apparent cause being their inability to realize how such a superior light could be furnished at such a small cost. They accordingly combined against the electric light company and secured the introduction of gas. The victory for the gas companies was only temporary, however, and served to show the inferiority of the old system of lighting. Even the country members soon regretted the step they had taken, and now preparations are being made to again replace gas with electricity.

Arrangements have been made with the Brush Electric Light company of Cleveland, O., for the construction of the necessary machinery, and the arrangement of wires, appliances, and lamps, for the Patent Office building in Washington, in order to light it completely by electricity. The department will be able to furnish its own light at such a diminished cost, that it is believed the saving from the average annual outlay heretofore sustained will, in three years, reimburse the expenditure for the plant. There are such vast piles of public papers, records and documents in the various rooms, halls and cellars of the department, many of these so dark as to require light throughout the day, that a mode of illumination which is consistent with their safety, becomes of prime importance. It is believed that this object has been secured by the arrangements made under the direction of Lieut.-Commander Bradford. Secretary Vilas believes the electrical equipment of the department will hardly be equaled in the country.

The New York Accumulator company recently made a temporary installation in Dr. Webb's residence, in New York, on the occasion of a reception. There were two series of thirty-five cells each of 15A cells, which were connected in parallel and supplied current for ninety 16-candle power lamps from 6 P. M. to 4 A. M. These cells were charged at the company's works at Newark, and carted to Dr. Webb's residence on the day of the ball, where they were placed in the basement. The lamps were used for the illumination of the ballroom and banquet hall. In the former room there were sixty lights, which were suspended from the cornices and formed a border on four sides of the room. Beneath the lights was stretched a width of very thin transparent pongee silk, which agreeably tempered the light and gave it a pink tinge. The ceiling and walls of this room are very handsomely frescoed and the light illuminated the paintings effectively. In the dining hall there were thirty lights distributed in a somewhat similar manner, the lamps being inclosed in decorative globes, some of cut glass and others, opal, arranged uniformly between the carved panels of the wall. The effect in both rooms was extremely effective.

Interesting experiments have been made on Hampstead Heath for the purpose of testing the capacity of small electric hand lamps in searching for the wounded men left after a battle, and thus more rapidly than hitherto bringing the sufferers within the reach of surgical aid. The experiments were made by the officers and men of the London Division of the Volunteer medical staff corps. The corps, accompanied by ambulance wagons and provided with stretchers, halted upon one of the Heath roads at a time when the thick mist still hung heavily upon the lower grounds; and having established a field hospital in a rather dreary looking spot, poorly sheltered by bare trees, sent out its searching stretcher parties to pick up the bandsmen who had been distributed over the open ground at some distance off, to simulate the wounded left from a fight during the daylight. By the aid of the lamps thus brought into such use for the first time the men sought were found with comparative rapidity, the lights being sufficient also to enable the trained ambulance men to apply preliminary bandaging upon the spot, and before loading the stretchers, which by other lights at the wagons were guided back to the road. There the men were carefully placed in the vehicles and conveyed to the field hospital, where the examining surgeons found very little to correct in the treatment adopted under such disadvantageous circumstances. The results achieved indicate sufficiency well says the *Daily News*, that the electric light thus used would be of immense value and tend greatly to reduce the suffering of men left upon the field at the close of a fight.

THE ELECTRIC MOTOR.

Leonard & Izard, Chicago, have received an order for a ventilating plant for the Pfister & Vogel Leather company, Milwaukee. Motors will be employed to drive the ventilating fans, and will receive their supply of current from the incandescent plant, which is already in operation.

C. M. Barclay of the Chicago office of the Sprague Electric Railway & Motor company has sold to A. McNally a 15-horse power motor, which will be used in the latter's building at 109 Wabash avenue, Chicago, for pumping water for the passenger elevator. Current will be taken from the Edison circuit.

The Pennsylvania Railway company, last week, closed a contract with the Sprague Electric Railway & Motor company for the complete equipment of their system of electric street railways at Atlantic City, N. J. Before awarding the contract the Pennsylvania Railroad appointed a committee, which made a careful investigation of the merits of the different systems of street railway propulsion.

Last week the Asheville, N. C., Electric Street railway, which was installed by the Sprague Electric Railway & Motor company of New York, was successfully put in operation. The first trial trip of the motor cars was made on January 21st, and proved a great success. The run was made over the entire distance of the line, about two miles, in less than eight minutes, the car carrying a large number of passengers. Upon reaching the terminus of the line, which is at the new W. N. C. railroad depot, the party was welcomed by cheers from the citizens who had gathered to greet its arrival, and by blowing of whistles from all the locomotives at the depot. The citizens of Asheville are enthusiastic over the new electric line, and the directors of the road express themselves as well pleased.

[illegible]

[illegible] to connect [illegible] by means of overhead wires is no longer an experiment, either [illegible]. It [illegible] stage, and [illegible] has no longer any [illegible]. And it will not be very long [illegible] before Mr. Holmes will have electric cars in operation in Davenport. Certainly the great success of the Brady street line with electricity causes the mule system to appear slow, dirty and vexatious, and costly in operation by comparison."

A resident of Toledo who was opposed to the introduction of electric railways recently wrote a friend in Omaha regarding the Omaha & Council Bluffs electric railway constructed by the Thomson-Houston company. In the reply was the following statement of facts which, according to the Toledo *Blade* changed his opinion and he now favors electric railways: They are operating about five miles of double track; building the road in the ordinary way, excepting that each line is wired and each rail length is connected to this wire, which makes a complete circuit without the rail. This cable or ground wire is grounded, as occasion demands, thus disposing of the surplus electricity and avoiding accidents. The motor cars are provided with two 10 horse power motors, which are capable of taking 200 passengers over the bridge approaches (which are 3 per cent grades) better, you may say, than a locomotive of the same power can do—at least, that is my experience. The power house is located midway on their line, and consists of two Westinghouse automatic compound engines of 100 and 150 horse power, using, one 40 and two 80 horse power dynamos. I was told they could supply power to outside parties at $100 per month for 30 horse power, and make money at that too; but to do so the parties must furnish their own motors, which are not expensive. These motor cars are able to run as high as 25 miles per hour, but the ordinary speed is about fifteen miles; they stop and start, go slow or fast, and as far as I can see are perfectly under control and as easily handled and managed as the ordinary steam locomotive.

The West End electric railway at Boston is running successfully, and carrying a large number of passengers each day between Park Square and Brighton. The cars run rapidly, and are under very quick and perfect control. The residents in Brookline, who used the cars regularly in coming into Boston and returning, are very enthusiastic over the celerity of the cars, and the time saved over the ordinary horse-car. The change of the overhead to the underground system is made very quickly and without stop, so that no delay is experienced at this point. The car drivers, or "Motorneers," as some Bostonians persist in calling them, are street car drivers, who have been detailed to operate the electric cars, and who have learned their necessary duties very quickly. All of these old drivers are very enthusiastic over the ease with which an electric car can be operated.

On January 20th a heavy snowstorm reached the city and covered the tracks of the railway to the depth of from two inches to a foot. The electric snow-plows which are being equipped by the Sprague company for use by the West End road had not been finished, and the cars were obliged to run without this aid for clearing the tracks. The cars were successfully operated however over the entire road, clearing their own way, and carrying large numbers of passengers.

The Boston *Herald*, in commenting on the road, says: "Those who have made the experiment of taking a ride on the new electric railway on Beacon street, must have come to the conclusion that this method of securing rapid transit in the suburban wards is one of the most promising that has yet been brought forward in this city. The speed attained where the conditions are favorable is quite equal to that of the elevated railroads in New York City, while the structures supporting the electric wires are by no means as much of a disfigurement as it was at one time supposed that they might be. So long as a mixed service is maintained that is, so long as some of the cars are drawn by horses, the full advantage of the electric system cannot be realized. The speed of the electric car has to conform to the speed of the horse car which may be in front of it, but if the experiment proves as successful as there is now every reason to think that it may, the West End company will before long feel compelled to substitute electric for animal power in the service of all of its lines. When that change is brought about, the speed that can be made, even in the center of the city, will be very much accelerated over the average speed of to-day."

THE TELEPHONE.

The manager of the Savannah (Ga.) Telephone exchange claims the distinction of answering the greatest number of calls per day per subscriber of any exchange in the country.

The Milwaukee (Wis.) Telephone company has decided to bury its wires. A representative of the company thus explains the reason for this action: "Although underground wires are yet an experiment, we are willing to try

them, not because we are compelled, but because they will [illegible] We [illegible] the fact that wires [illegible] danger, and that the public will be better served when they are removed."

A Connecticut man has brought suit against the telephone company [illegible] abusive language, says an exchange. He called for a doctor, and the operator replied that he [illegible] ringing again a little later, he heard the operator say: "Let the fool ring," and on remarking that he [illegible] ringing for half an hour, he received the terse retort, "You're a liar." A man at the telephone [illegible] if there is a delay of five minutes in accomplishing a thing that might take him many hours to do in any other way.

Speaking of the value of the telephone, for use in the country in connection with a proposed State Weather Bureau service, a recent pamphlet by Prof. F. M. Nipher, of Missouri, says: "In 1893 the telephone will become public property, and it will then be possible for county telephone services to be established, putting each farm in communication with the county seat. Telephone service can be rendered for a sum which will be utterly insignificant when compared with the advantages which it will bring. Farmers can then keep informed of the markets, can sell their produce before leaving their homes, and will be able to save much time which they now waste during the busy season of harvest. In addition, there will grow up a system of harvest storm warnings. It will be very easy for any county telephone system to give its subscribers a general warning of an approaching thunderstorm, and to transmit that information to such other counties as may be in danger. It seems certain that this can and will be done, and there is no reason that this should not be done by the national weather service."

THE TELEGRAPH.

Freaks of the telegraph are often amusing though usually annoying. The following telegram received at a leading Chicago house last week set the entire establishment at its wits' end for a time: "Agent Leman will be at your office at 6 P. M. to get information on machinery." No one knew "Agent Leman," and after considerable study and speculation they stumbled on the fact that the dispatch should read, "A gentleman" instead of "Agent Leman."

Information is received from Ottawa that by August 1st a connecting line of wires between the commercial cable at Canso, Nova Scotia, and the Canadian Pacific Telegraph system will be completed. This is an important event in the history of telegraphic communication throughout Canada, both to the mercantile community and the press of the Dominion. The reports of current events in Europe have hitherto been meager and unsatisfactory to Canadians, but by the new arrangement they will be furnished with the kind of news they may think most valuable.

The extent of the storm that recently swept over the country can be estimated from the following statement of a Western Union Telegraph company employe in the Rochester *Post-Express:* There were 1,000 poles down between here and Syracuse, and at certain points where the wind struck wires and poles favorably, the latter were lifted out of the earth, dashed on the railroad track upper end down and toppled over so that the butt ends lay further from the post holes than the cross-tree end. The storm that blew down the suspension bridge at Niagara Falls prostrated our wires all through this quarter of the state, and gave the company a chance to show what it can do in an emergency. It so happened that when the storm struck Buffalo, General Superintendent of Construction Doran was in the city, and he was equal to the emergency. Seeing that there would be extensive damage done he telegraphed for car loads of wire and gangs of men to all the important points from Cleveland to New York, and had men and material enough in Buffalo next day to put a man on every pole. Mr. Doran is an old army telegraph man, and handled the line after the storm in a masterly way

Speaking of the cry of monopoly in reference to telegraph companies Superintendent W. B. Somerville, of the Western Union Telegraph company, said recently "It used to cost 10 cents per word to send dispatches to San Francisco. Now it costs 1¾ cents, although there is now no competition since the Western Union owns all the lines. The general average rate per word over the country is [illegible] per word. That doesn't look much like [illegible] the so-called monopolists sometimes get very much the worst of their business, [illegible] as well as for other things? Now, [illegible] Bar Harbor more fashionable than [illegible] people began to rush there, there [illegible] Our line connected [illegible] Bangor [illegible] company owned the wires from Bangor to Bar Harbor. We charged 25 cents per [illegible] 50 cents [illegible] Bar Harbor. What was the [illegible] called a grinding [illegible] bought out the [illegible] through to Bar Harbor [illegible] to Bangor [illegible] each message [illegible]

Miscellaneous Notes.

[illegible]

recent experiments by W. H. Preece, says *Industries*, it is actually only 6.034 times that of copper. The exact determination of the resistance of iron is of considerable importance, especially now, when through the operations of the copper syndicate the price of this metal has been forced up to a figure which precludes its use for electrical purposes.

Ex-Mayor Hewitt of New York city, as is well known, did not act in harmony with the Electrical Subway commission. In reviewing his course the ex-mayor said recently: "The commission for the construction of the electrical subways was organized against the unanimous protest of the city officials, who had recommended the addition of the mayor, comptroller and commissioner of the public works to the commission, but the latter two officers were omitted. The consequence has been that the work has gone on in a manner which has been exceedingly destructive to the use of the streets, and the result is believed by many competent experts to be an entire failure. The only consolation is that it is not paid for out of the city treasury. The importance of burying the electrical wires is so great that it is to be hoped that some means may be found of making the existing conduits of use, in order that the improvement may not be indefinitely postponed."

A member of the New York Electric club has designed a door opener which relieves the disgusted traveler or visitor from the necessity of shoving a heavy mass of wood with his hands, or of wearing out the toes of his boots in kicking it back. A metallic plate set in the floor a foot from the threshold is marked "door opener." The caller treads upon it in the same style as the peaceful street car horse treads upon the clumsy iron switch plates, which now ornament every street where this kind of locomotion is in vogue. The plate yields a quarter-inch to the pressure of the foot and forms a circuit which immediately starts a tiny electric motor that in turn opens the door, despite door spring, air valve or counterweight. The moment the visitor passes in the plate is thrown back by a coiled spring to its former position, the circuit is broken, and the door closes itself with or without a resonant bang as may be desired. With swing doors the plate is inset on both sides of the portal. With double church doors two pairs of plates are arranged so that the sexton can connect or disconnect each pair; when the plates are connected the worshiper's foot opens both doors, but when disconnected, only one.

Personal Paragraphs.

M. G. Kellogg of Chicago has returned from his southern trip.

P. C. Ackerman of the New York office of the American Electrical works, was in Chicago last week.

W. M. Callender, general manager of the Callender Insulating & Waterproofing company of New York, sailed for Europe January 26th.

J. Edgar Jones, formerly of Fairbanks, Morse & Co., Chicago, has accepted a position with the Van Depoele Electric company. He will have charge of the steam plant and installations. William Fay, who has had charge of the electric light plant at the Union depot, Chicago, will hereafter be in the sales department of the same company.

E. T. Watkyns has been elected president of the Chicago Edison company, and will personally superintend the management of the affairs of that company. The old board of directors was re-elected. President Watkyns and Vice-president Doane made an eastern trip last week, and consulted Mr. Edison on matters pertaining to the system. The Chicago company has been highly successful, and under Mr. Watkyns' management will continue to prosper.

Business Mention.

A circular from the Hawkeye Electric Manufacturing company of Davenport, Ia., states: "The factory and office of this company are now being removed from Oskaloosa, Ia., to Davenport, Ia., and on and after January 23, 1889, all communications for this company should be addressed to Davenport."

The Sioux City, Ia., Foundry and Machine works have sold to the Beatrice Electric Light & Power company, Beatrice, Neb., a 100 horse power Corliss engine and a 100 horse power boiler.

Electrical Patents.

Issued January 22, 1889.

396,403. Electric Meter. Marie J. R. Jacquemier, Paris, France.

The invention relates to that class of electric meters which operate on the principle of automatically taking the reading of an ammeter at stated intervals of time, and mechanically adding the successive readings together by means of a registering or totalizing mechanism.

Of the fifteen claims we give the eighth "The combination [illegible] device and a detector [illegible] adapted to impart motion to the [illegible] and a detent adapted to be disposed by the movement of said lever upon its [illegible] member of the electromotive [illegible] movement, to arrest said [illegible]."

[illegible] Electric Wire Conduit. John Lynch, Washington, D. C.

[illegible] rectangular and pro[illegible] of uniform thick[illegible]

[illegible] on of Alternate Current Generators. [illegible]

The first claim is as follows: "The combination, with an alternating current dynamo, of a separate exciting dynamo having its field magnets provided with two sets of coils, one set being included in the circuit of the field magnet coils of the alternating current dynamo, and the other set being included in a shunt across the brush terminals of the alternating current dynamo."

396,439. Electrical Switch. Elmer A. Sperry, Chicago, Ill.

The switch is designed to automatically switch out a portion of the electric circuit, from which a portion of the current has been diverted.

The last claim is given: "7. The combination of main line with a service loop thereon, a duplex switch whose arms complete the connections with the main line, a differential magnet through which the loop current passes in opposite directions, a retracting spring connected with such switch, and a catch to hold such switch, said catch controlled by the magnet, so as when released to release the switch, and permit the loop to be cut out of the main line."

396,450. Municipal Telegraph System. Theodore J. Zoeller, Louisville, Ky.

396,465. Sounder Attachment. George H. Carey and William McArthur, Dollarville, Mich.

396,513. Underground System of Electric Wires. Henry B. Cobb, Wilmington, Del.

396,549. System of Electrical Distribution. Edward N. Dickerson, Jr., New York, N. Y.

The system is designed to change a direct high tension current at a point of conversion into a direct low tension current.

396,557. Dynamo for Telegraphic Purposes. Berthold Gmur, Schanis, and Otto Flatz, Niederurnen, Switzerland.

396,579. Wiring Block for Electrical Circuits. Osborn P. Loomis, Somerville, Mass.

396,580. Coupling Dynamos. Osborn P. Loomis, Somerville, Mass.

The invention relates to the coupling of compound wound dynamos when arranged in multiple arc to supply an electrical circuit.

The second claim reads: "The combination, with dynamo machines arranged in multiple arc in an electric circuit, of electro magnets arranged in the circuits emanating from said dynamos, contacts controlled by said electro magnets as one or the other dynamo overbalances the other, and electrical connections from the field magnet coils having their terminals arranged in the path of said contacts."

396,581. Coupling of Dynamos and Motors. Osborn P. Loomis, Somerville, Mass.

396,582. Automatic Ground-Detector for Electric Circuits. Osborn P. Loomis, Somerville, Mass.

396,583. Incandescent Lamp Socket. Osborn P. Loomis, Somerville, Mass.

396,602. Combination of Electric Generators. Edwin W. Rice, jr., Lynn, Mass.

The invention consists in supplying the working circuit from two or more generators, one generator supplying a definite amount of electricity, while the other is regulated so as to adapt the current supply to changes in the resistance or work to be done on the circuit.

396,603. System of Electrical Distribution. E. Wilbur Rice, jr., and Albert L. Rohrer, Lynn, Mass.

The invention is designed to be used in connection with potential equalizers consisting of induction transfer coils.

Claim 2. "In a station apparatus for an alternating current system of distribution, a branch from the supply mains, containing a reactive coil, and indicating appliances connected to said coil."

396,618. Electric Railway Trolley and Support. Sidney H. Short, Columbus, O.

396,632. Time Switch. Benjamin E. Waters, Brockton, Mass.

396,633. Electric Railway System. David G. Weems, Baltimore, Md.

The invention consists in the combination, with upper and lower rails, and stops on the line of road, of an electrically operated car, means for conveying the current thereto, and adjustable housings on the car having levers, which are actuated by the stops.

396,645. Electric Time-Meter. George F. Card, Covington, Ky.

396,649. Turn-Table for Cable or Electric Railways. Ward Davidson, Oakland, Cal.

396,667. Burglar Alarm. Arthur C. Robbins, Brooklyn, N. Y.

396,681. Secondary Battery Charging. Charles F. Brush, Cleveland, O. Filed May 21, 1883.

The invention consists in certain means for automatically manipulating the current employed in charging the batteries. The apparatus is especially designed to regulate the charging of many batteries from a single current source.

Of the thirteen claims the sixth is given. "The combination, with an electrical generator, a main or charging circuit, and a secondary battery, of switch mechanism for connecting the opposite ends of the battery with the charging circuit, and electro magnets included in the charging circuit and circuit including the battery and arranged to actuate the switch mechanism and automatically connect the opposite ends of the battery with the charging circuit when the electrical potential of said battery shall have reached a predetermined minimum."

396,701. Burglar Alarm. Geoffrey B. Lehy, Medford, Mass.

WANTED: INCANDESCENT LIGHTS.

In a thriving town of 6,000 population, to increase the electric light plant so as to include incandescent lights. The present plant consists of two 45 light arc machines (Brush), and 1,200 candle power lamps. Present company has contract for city lighting, and will sell part interest or entire plant to parties who will agree to install incandescent system.

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Consisting of Machinery, Tools, Implements, Ovens, Crude and Manufactured Materials. A most complete, first-class and new plant ready to start at once.

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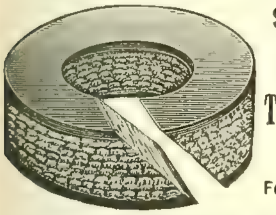

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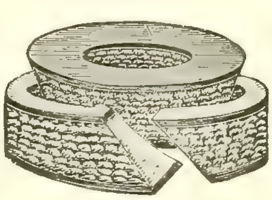

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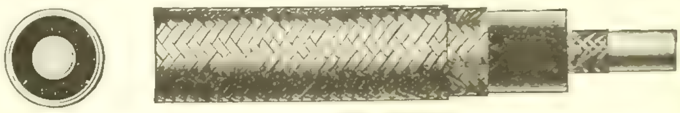

In a letter from the INSPECTOR of the **Boston Fire Underwriters' Union**, under date of March 29, 1886, he says: "**A Thoroughly Reliable and Desirable Wire in Every Respect.**"

The rubber used in insulating our wires and cables is specially chemically prepared [illegible] *to be waterproof*, and *will not deteriorate, oxidize or crack*, and will remain flexible in [illegible] and not affected by heat. The insulation is protected from [illegible] whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a [illegible] *Our insulation will prove durable when all others fail.* We are prepared to furnish [illegible] gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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61 and 63 Hampshire Street, Boston, Mass.

HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.

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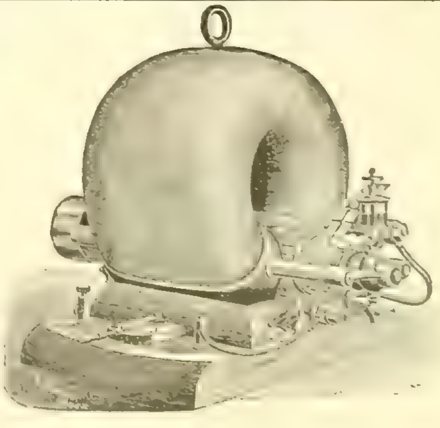

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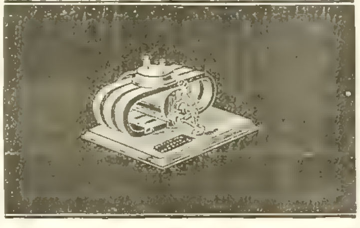

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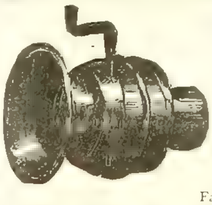

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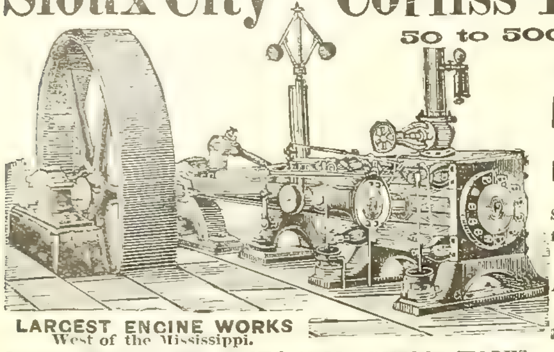

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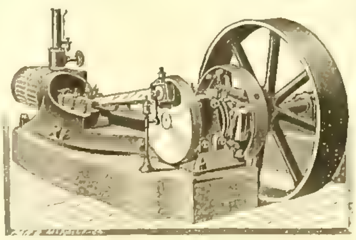

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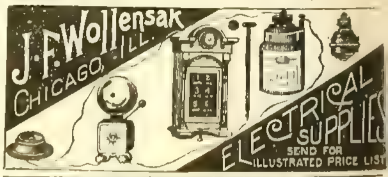

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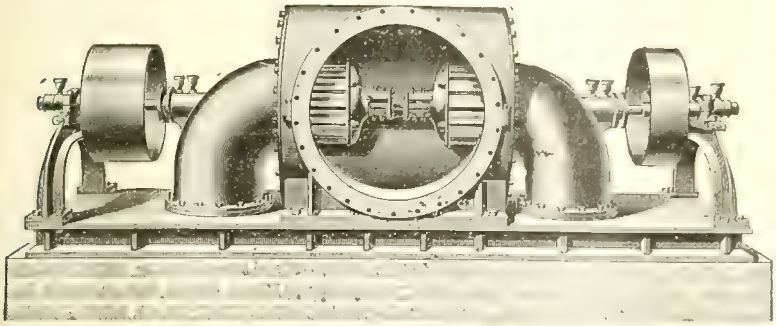

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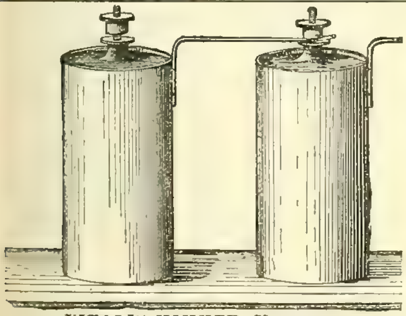

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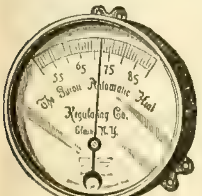

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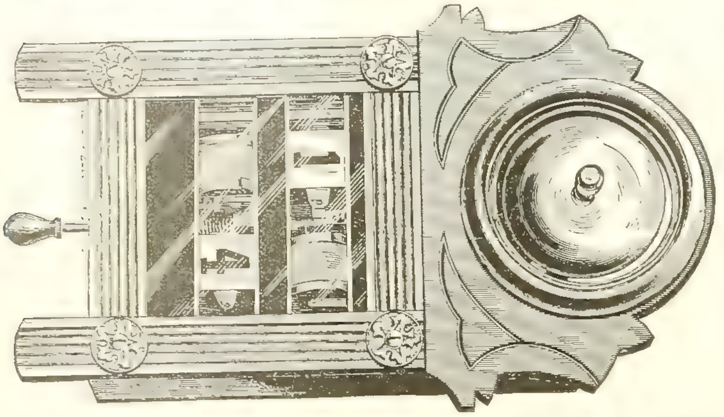

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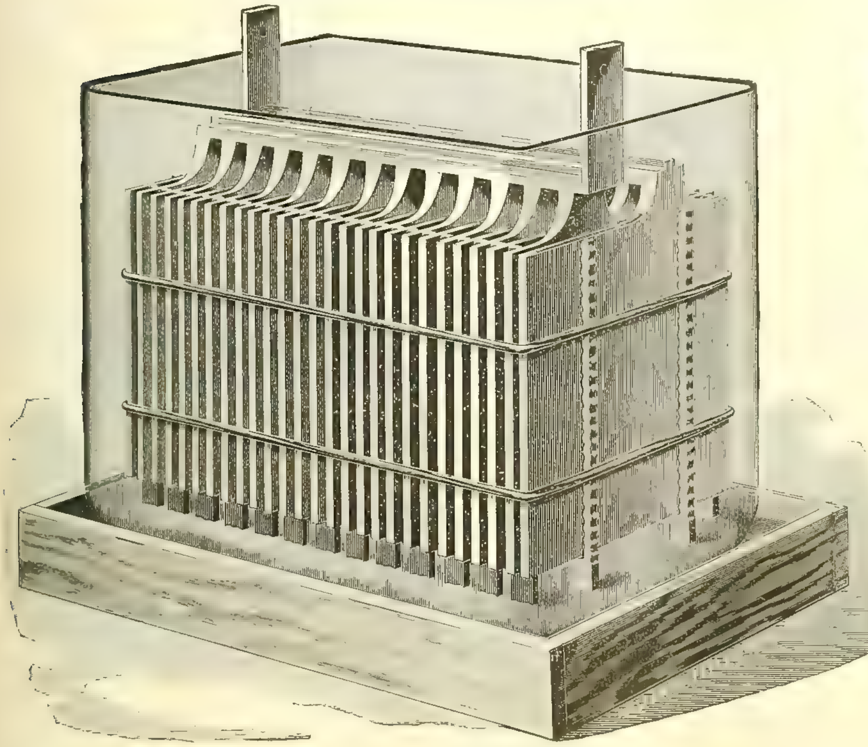

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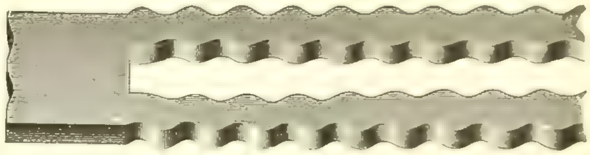

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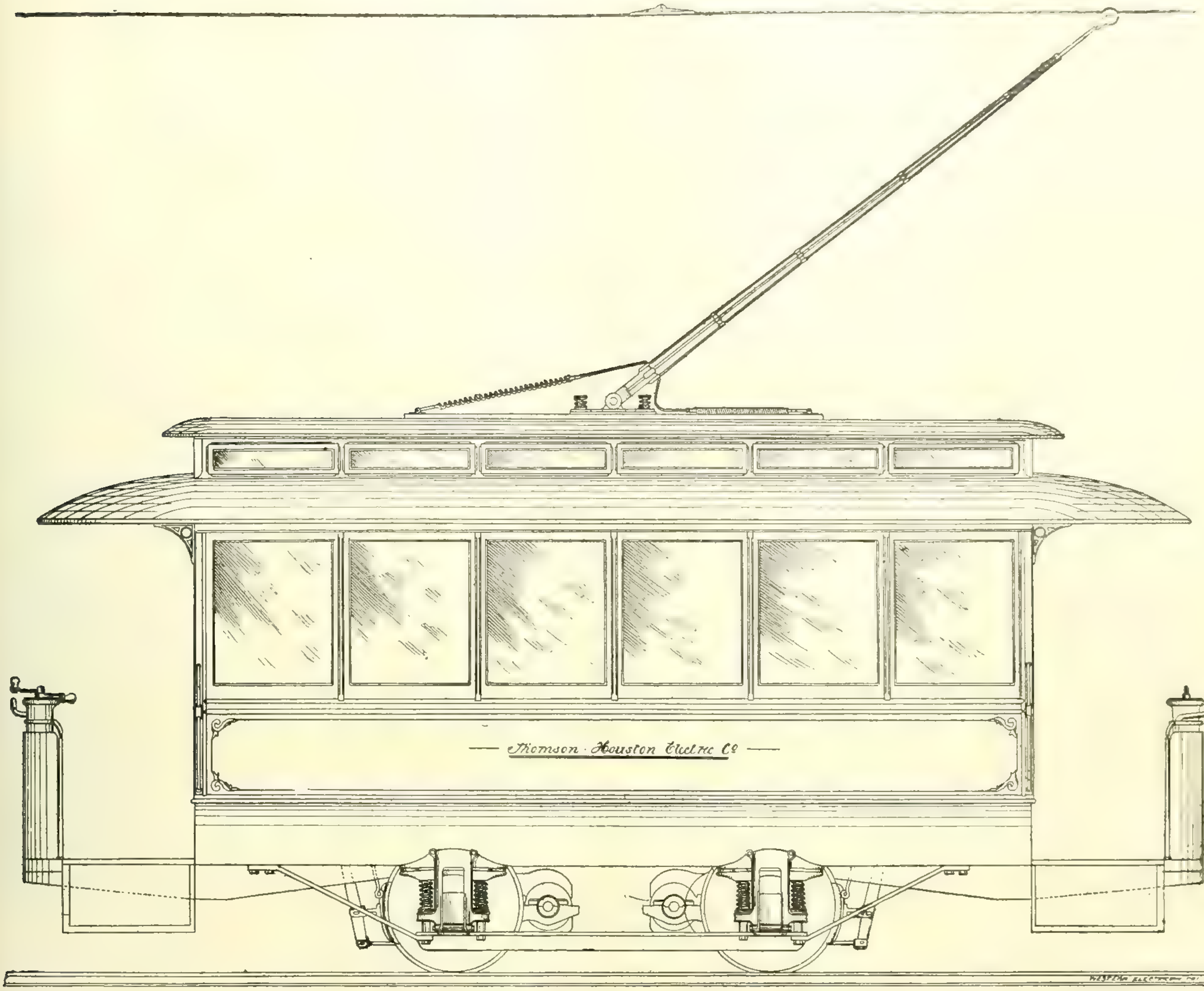

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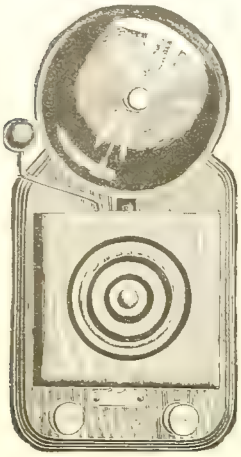

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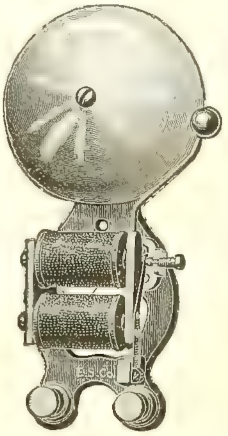

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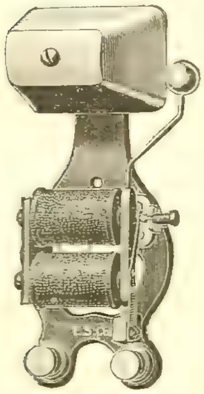

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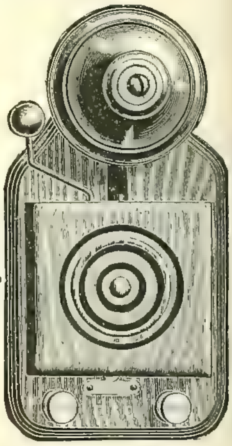

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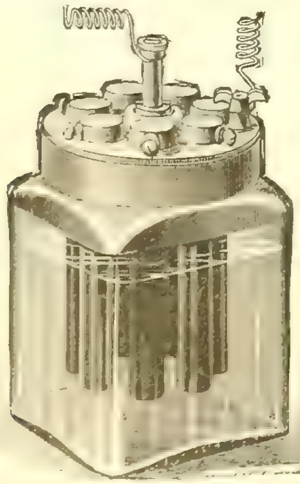

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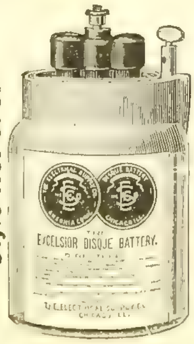

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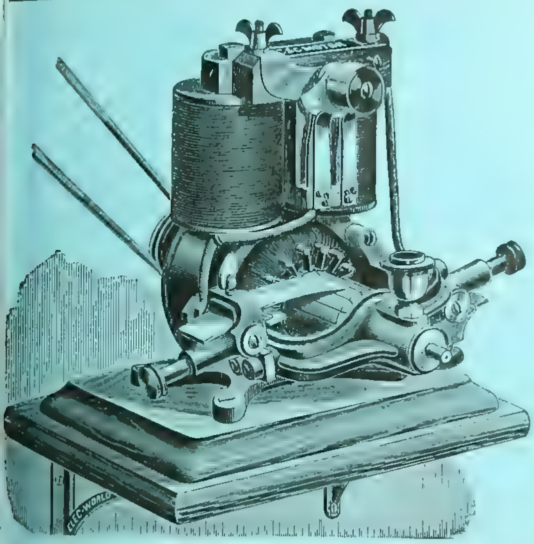

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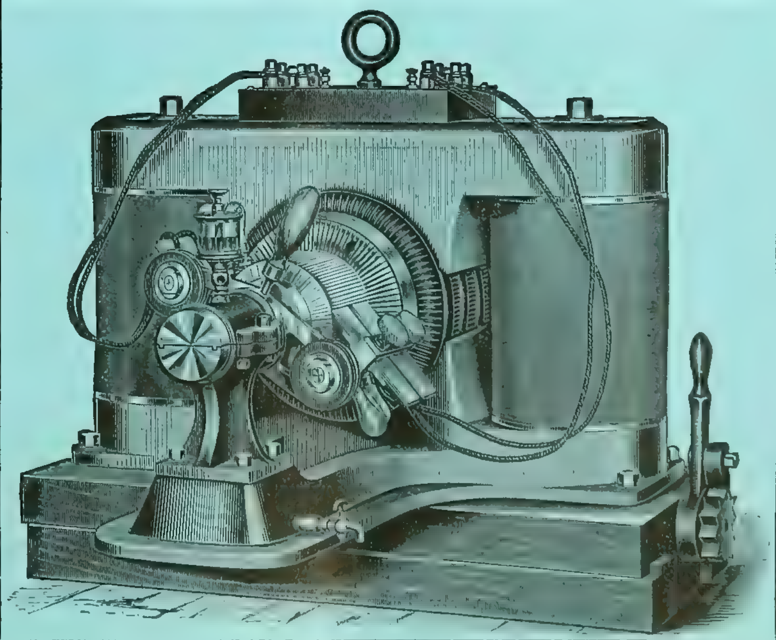

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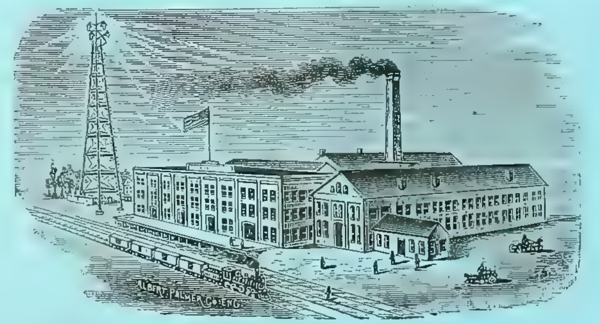

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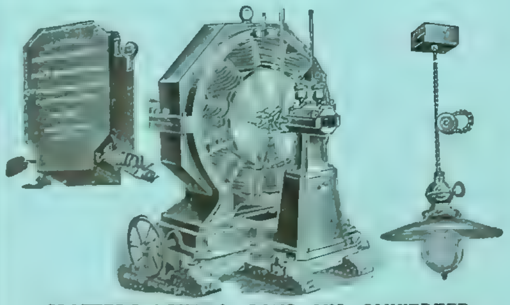

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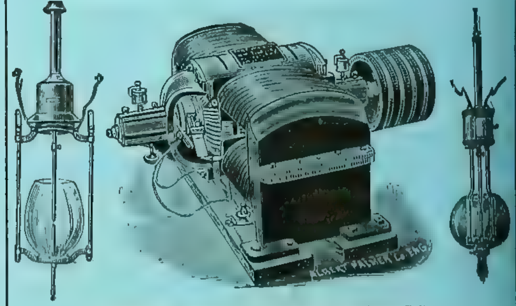

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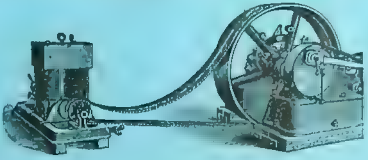

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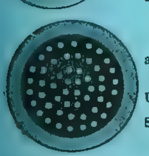

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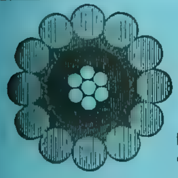

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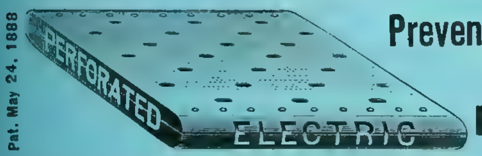

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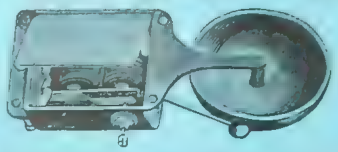
Superior to  All Others.

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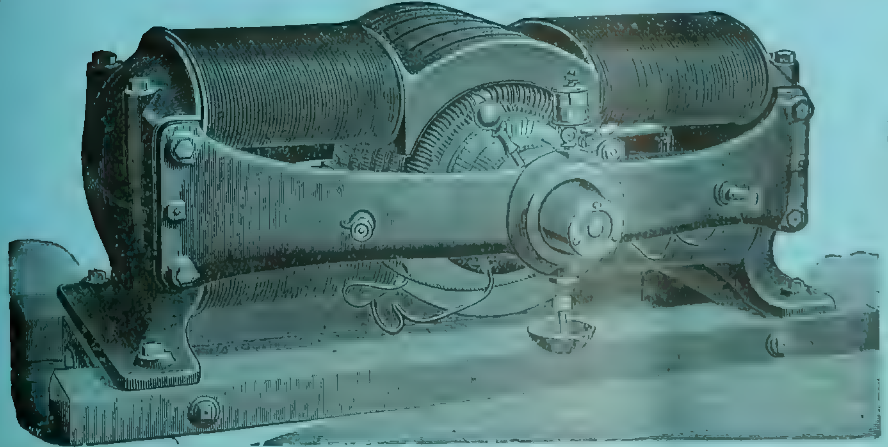

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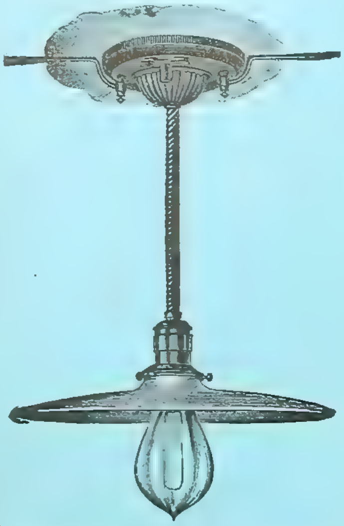

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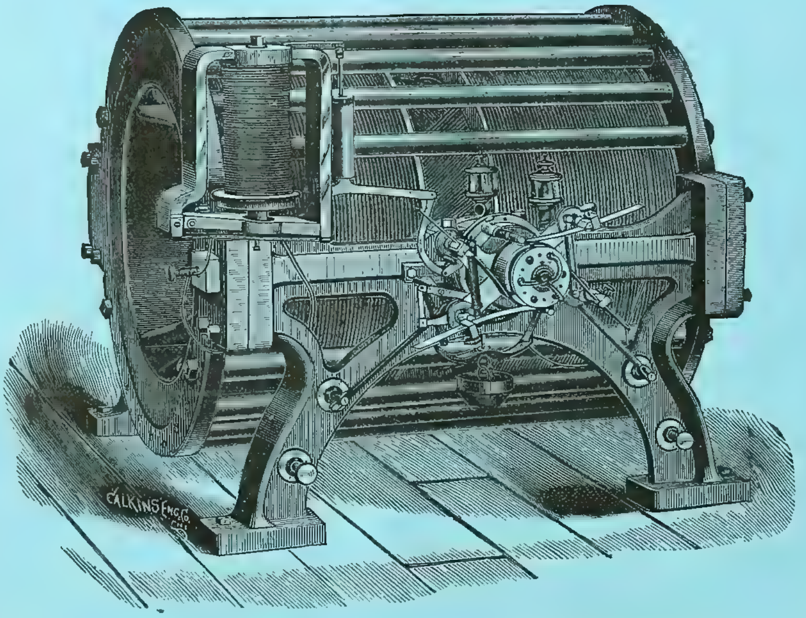

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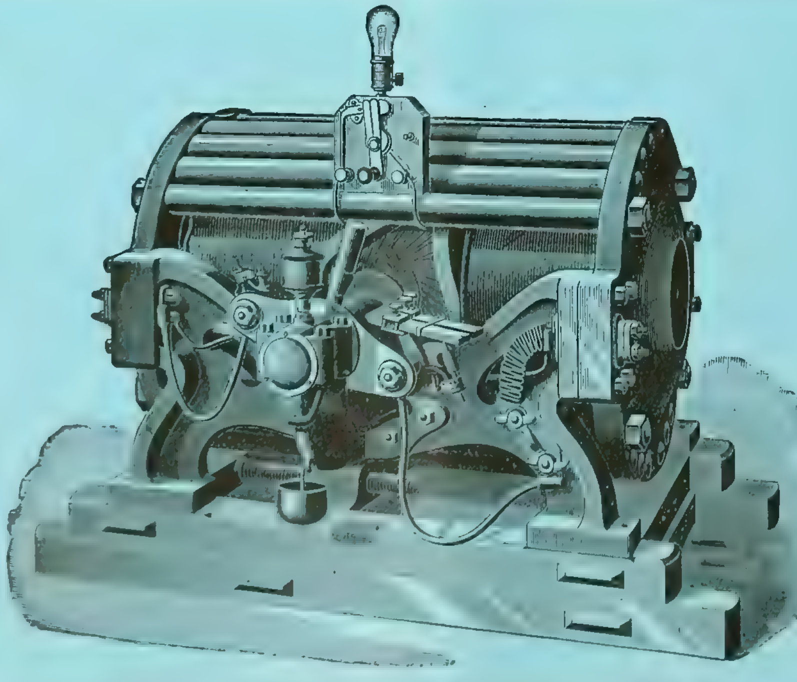

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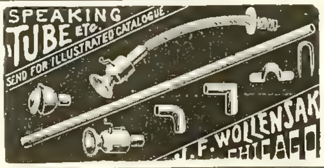

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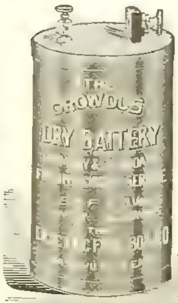

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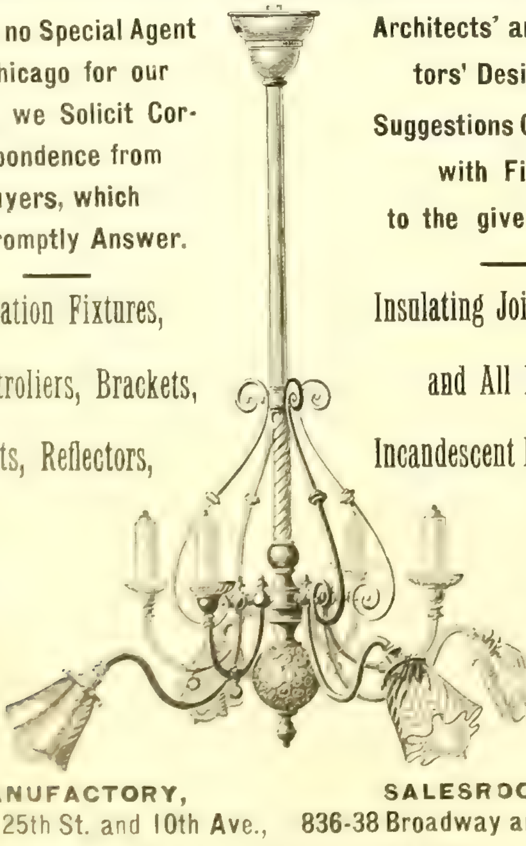

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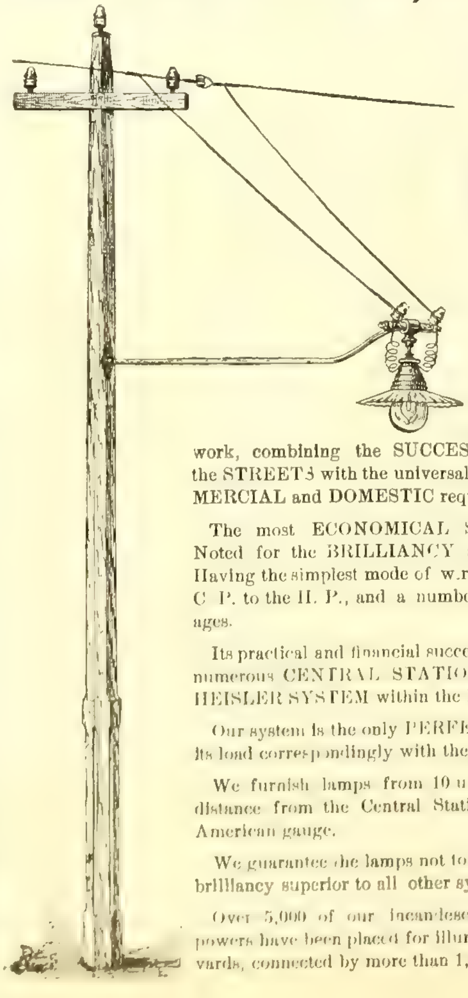

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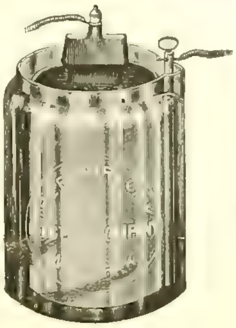

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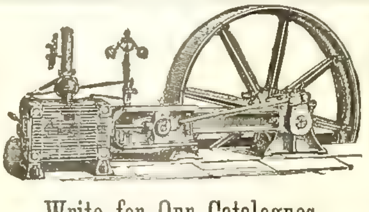

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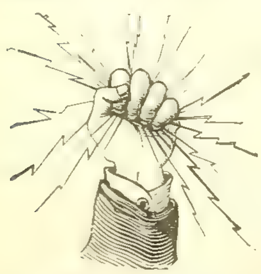

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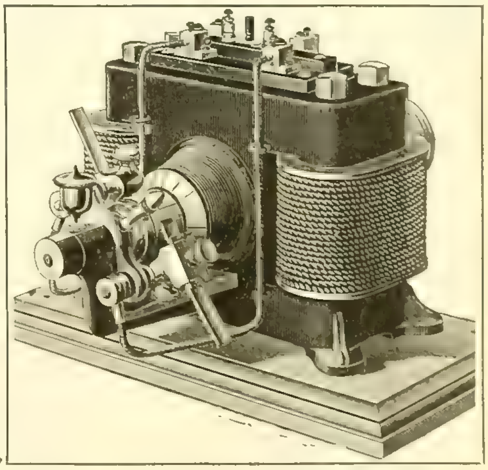

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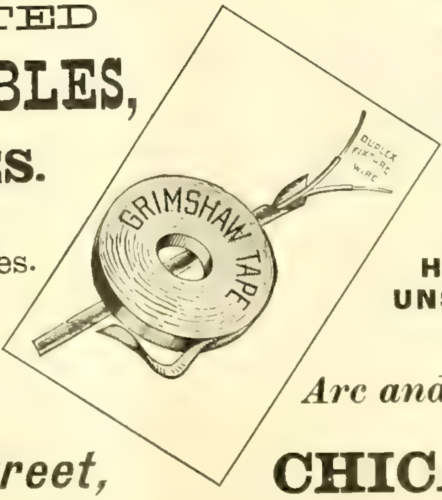

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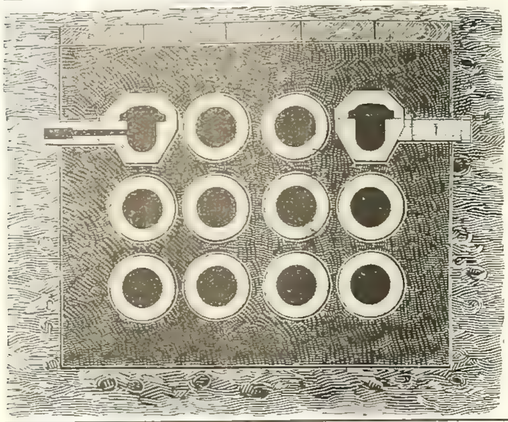

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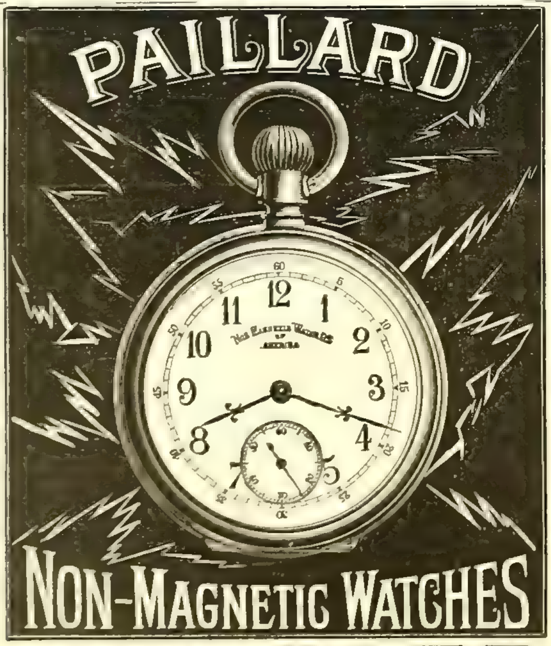
Fire and Burglar Alarms.
Electro-Medical Apparatus.
Electric Lighting.
Telegraph Instruments.
Wire and Batteries.

The United Electric Co.

Electrical Apparatus and Supplies,

SALT LAKE CITY, - UTAH.



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—BY—

Thomas A. Edison, Elihu Thomson, N. S. Possons, Edwin J. Houston,

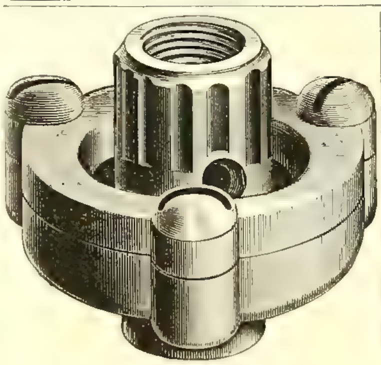
AND SCORES OF LEADING ELECTRICIANS.

FOR SALE BY ALL JEWELERS.

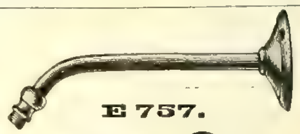
Send for Pamphlet "ARE YOU POSTED?" to

NON-MAGNETIC WATCH CO.,

177-179 Broadway, N. Y.



E 463.
INSULATING JOINT.
(THE STANDARD.)



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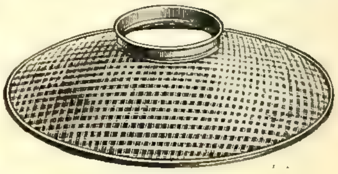

E 800.

E. P. GLEASON MFG. CO.,

181-189 MERCER STREET,

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CHICAGO OFFICE, 233 LAKE STREET.

—MANUFACTURERS OF—

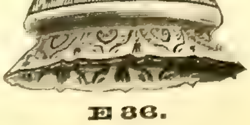
ELECTRIC APPLIANCES

IN BRASS, IRON, TIN AND GLASS,

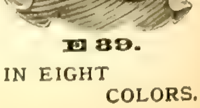
Embracing Fittings, Brackets, Fixtures, Shades, Globes, Insulating Joints, Cut-outs, Holders, all Systems, and Supplies for Arc and Incandescent Lighting.

SEND FOR CATALOGUE "E" 1889.

E 48.
CRYSTAL.



ETCHED.
E 36.



E 39.
IN EIGHT COLORS.

THE Westinghouse Electric Co.,

PITTSBURGH, PA.

[Manufacturers under Patents and Applications for Patents controlling the sale and use of Alternating Current Electric Lighting Apparatus and Distributing Systems.]

The success of the Alternating Current System of Electric Lighting is demonstrated beyond question.

Note the sale of 143 Central Station Plants by this Company, aggregating a total generating capacity of 250,000 16-candle-power lamps, within the brief period of twenty-five months, together with the fact that out of these 143 Central Stations, 38 have increased their plant since starting.

IMPROVED LAMPS.

By reason of an improvement in the manufacture of Lamps which has been secured for the exclusive benefit of the users of apparatus furnished by the Westinghouse Electric Company, this Company will guarantee from its Apparatus and Lamps 50 per cent. more light from a given expenditure of power (fuel) than can be obtained with any direct current system.

ALTERNATING CURRENT METERS.

This Company's Meter measures the whole current by a positive mechanical movement.

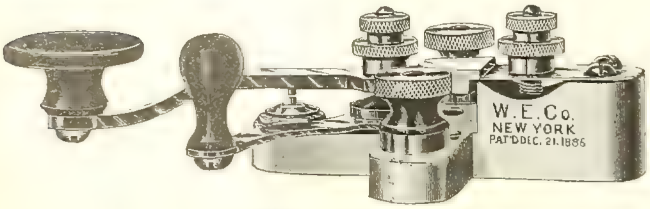
It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

ALTERNATING CURRENT MOTORS.

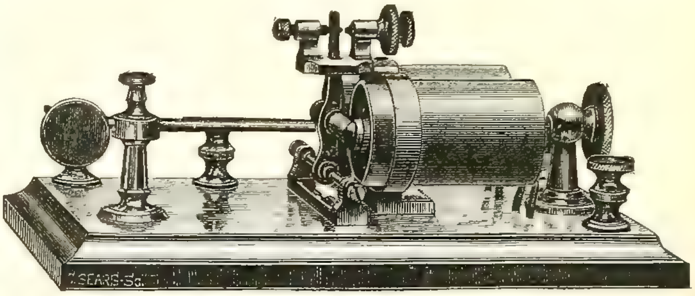
Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

Small Motors for use on existing Alternating Circuits of this Company.

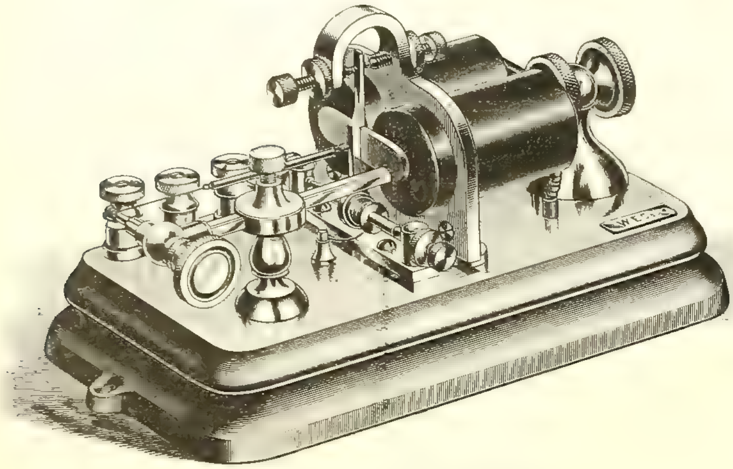
MORSE INSTRUMENTS.



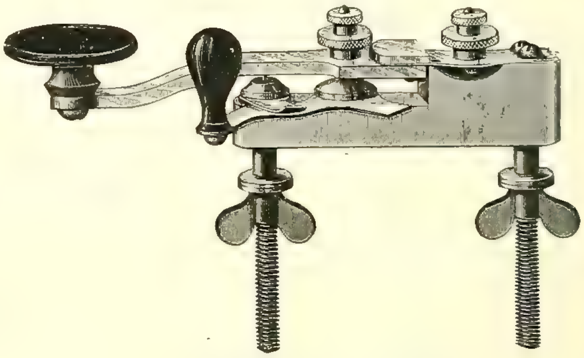
STEINER LEGLESS KEY.



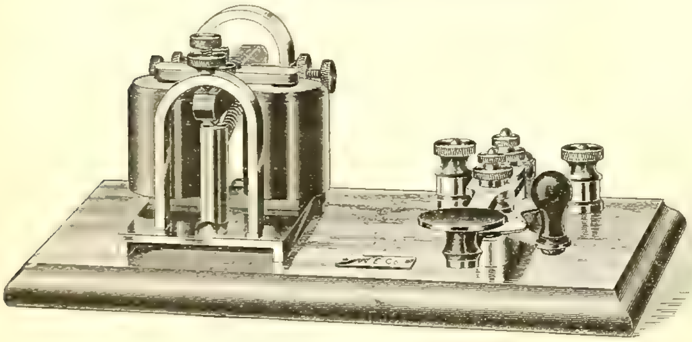
NO. 1 RELAY, CATON PATTERN.



NO. 2. WESTERN UNION RELAY.

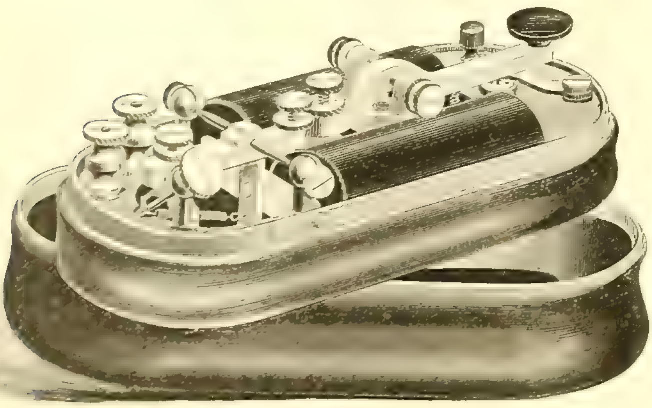


STEINER KEY WITH LEGS.

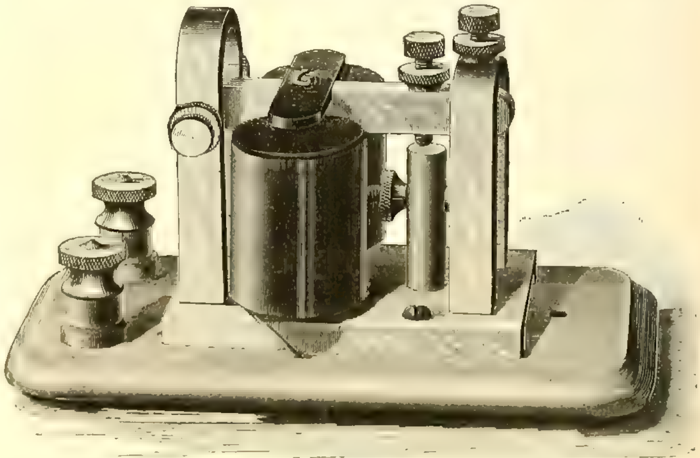


PRIVATE LINE INSTRUMENT.

BOX RELAY, WITH KEY.



POCKET RELAY.



SOUNDER.

PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. IV. CHICAGO, FEBRUARY 9, 1889. No. 6

Death of George L. Phillips.

George L. Phillips, president of the Chicago Telephone company and Central Union Telephone company, died at his home at Edgewater, near Chicago, January 29th, under circumstances peculiarly sad. Soon after the holidays he left Chicago to accompany his daughter to New York, where she was attending school. On his way home he was taken ill. Soon after he reached Edgewater malignant typhoid fever was developed. His condition soon became serious. Meanwhile news was received that the daughter whom he had taken to New York was seriously ill of the same disease. Mrs. Phillips left immediately for the metropolis. A dispatch was then received announcing the sudden death of two of Mr. Phillips' brother's children in Dayton, O. The daughter in New York grew steadily worse and died a week after Mrs. Phillips reached the bedside. The remains were taken to Dayton for burial, after which Mrs. Phillips, accompanied by Mr. Phillips' brother, hurried to Edgewater. The condition of Mr. Phillips had been so precarious that he had not been informed of the fatal termination of his daughter's illness. Mrs. Phillips reached home January 25th to find that her husband was in an extremely critical stage. He grew rapidly weaker, and on the following Tuesday passed away. The news was received at the telephone building in the afternoon. Although it had been known that he was in a most dangerous condition, death was not expected. Mr. Phillips was so strong and had inherited such a vigorous constitution, that his associates hoped with some confidence for his recovery. The entrance of the telephone building was draped in black.

Mr. Phillips was forty-three years of age. He was born in Dayton, O., and was the son of T. A. Phillips, proprietor of the cotton mills in that city. He entered the University of Michigan, joining the class of '67. He and his brother, Charles A. Phillips, who was in a subsequent class, were both members of the local chapter of the Sigma Phi fraternity. He left the university before graduation to enter the army. He joined the One Hundred and Thirty-first Ohio Regiment, commanded by Col. Lowe of Dayton. After leaving the army he returned to Dayton and assumed a position in his father's mill, and remained in the city for a number of years. During this time he organized the American District Telegraph company of Dayton. While his residence was in Dayton he organized, in 1876, the American District Telegraph company of Cincinnati. He remained president and principal owner of the latter corporation up to the time of his death.

Mr. Phillips organized the first telephone exchange in Dayton. He became president of the company and managed its business until the corporation was merged into the Central Union company. During his residence in Dayton Mr. Phillips was director of the Dayton National Bank, the Cooper Insurance company, the Cooper Hydraulic company, and the Dayton Gas Light & Coke company. He served several terms in the school board with such success, that at one election, at least, no opposing candidate was named, and he was chosen by a unanimous vote. He took the liveliest interest in the Dayton schools and devoted a great amount of time to his official duties.

Mr. Phillips' management of the Dayton exchange had been so vigorous that he received an offer of a position from the American Bell Telephone company. He went to Boston and took charge of the Boston exchange, and of the company's interests in the vicinity of that city.

In 1881 he resigned his position on account of the ill health of his wife, and returned to Dayton, making his home there for several years. In the same year he was appointed assistant general manager of the American Bell Telephone company, with headquarters in Chicago. He again resigned his position and, with his family, went abroad, and for a year and a half resided in Geneva, Switzerland. Leaving his family abroad, he came to Chicago in 1886 to take charge of the Central Union Telephone company, which was organized in 1883. He became its president April 12, 1886. A little over a year ago he was elected president of the Chicago Telephone company.

GEORGE L. PHILLIPS

During the year of his presidency of the latter corporation Mr. Phillips had occasion to exercise all his executive ability and ingenuity in the management of its affairs. Complications arose out of the disposition of the city council to interfere with the operation of the company's business in Chicago, and a determination to reduce telephone rentals. The company was without an ordinance authorizing it to transact its business in the city, and the municipal body refused to grant a franchise without provisions reducing very materially subscribers' rentals. Upon Mr. Phillips rested almost exclusively the task of directing the policy of the company in this critical period. Upon him devolved the duty of meeting and arguing with council committees. It was a work which extended over months. The result, as has been stated in these columns, was a substantial victory for the company, and the victory was due almost exclusively to the personal exertions of Mr. Phillips.

Mr. Phillips married Miss Mary Adele Bronson, a Dayton lady, in Dubuque, Ia., May 15, 1867. Four children are living: Margaret J., Isabel B., Jeannette T. and Mary Adele Phillips. The second daughter, Miss Mary Golden Phillips, died in New York recently. His brother, Charles A. Phillips, is a resident of Dayton. Mr. Phillips' home life was peculiarly happy. One of his friends said, a few days ago: "His was a wonderfully happy home. He never took his business away from his office, but gave himself up to a thorough enjoyment of his home."

Mr. Phillips was a man of magnificent physique, and the day before he left Chicago for his eastern trip seemed in perfect health. He was a man who made and retained friends. When the news of his death was sent out dispatches were received from all over the country expressing the deepest sorrow and extending sympathy to the afflicted family. Mr. Phillips was a member of the Union League, the Chicago club, Dayton Lodge, F. A. M., and Cincinnati Consistory Scottish Rite. He was director of the Western Electric company.

The family and friends left for Dayton January 31st. Funeral services were held on the afternoon of February 1st in the First Presbyterian church of Dayton, of which Mr. Phillips had been a prominent member. To the church Mr. Phillips, some time ago, presented an organ in memory of his mother

The funeral sermon was preached by the Rev. Prentiss De Veuve, pastor of the church. Between the deceased and the pastor there had existed the most confidential relations. Mr. Phillips had made many valuable presents to the church, but had always insisted that no publicity should be given to this fact The value of these gifts aggregated thousands of dollars, and no one but the pastor knew to whom the church was indebted for these generous contributions. Other instances were not wanting to illustrate Mr. Phillips' generosity, and in referring to these the Rev. Mr. De Veuve paid an earnest and eloquent tribute to the character and virtues of the deceased The services at the grave were no less impressive At the entrance to the cemetery the funeral procession was met by a hearse

bearing the body of Mr. Phillips' daughter, whose death had occurred shortly before her father's. It was a sad and impressive sight, and as father and daughter were laid side by side in their last resting place, every head was bowed and every eye was moist. The Rev. Mr. De [illegible] with emotion, and as he read the impressive funeral services wept like a child.

The floral offerings were numerous and beautiful. Among the larger floral pieces were a

[illegible] BLOWPIPE.

broken column presented by the Central Union Telephone company; a broken system of telephone lines by the officials of the Central Union Telephone company of Ohio; a floral telephone by the lady operators and other employes of the Dayton Telephone exchange; a bed of roses by the Western Electric company of Chicago. The following named gentlemen who accompanied the body from Chicago were honorary bearers: Norman Williams, vice-president of the Chicago Telephone company; F. A. Head, president Malleable Iron company; Col. R. C. Clowry, vice-president and general superintendent Western Union Telegraph company; George Sturges, president Northwestern National bank; A. M. Day, John Hinchman, R. C. Schenck and Joseph L. Silsbee. The pall-bearers were: W. S. Chapman, secretary and treasurer Central Union Telephone company, Chicago; R. C. Wetmore, secretary and treasurer Chicago Telephone company, Chicago; F. G. Beach, general superintendent Central Union Telephone company, Chicago; C. H. Wilson, general superintendent Chicago Telephone company, Chicago; John Young, Western Electric company, Chicago; H. H. Matlock, division superintendent Central Union Telephone company, Springfield, Ill.; Colonel Beetle, Western Electric company, Chicago; J. E. Zeublin, division agent Central Union Telephone company, Columbus, O. Prominent among those who attended the funeral were the following: Norman Williams of Chicago, vice-president Chicago Telephone company; [illegible] R. C. Clowry of Chicago, vice-president and general superintendent of the Western [illegible] ph company; F. H. Head, president Malleable Iron works, Chicago; George Sturges, president Northwestern National bank, [illegible] Chicago; E. M. Barton, [illegible] company, Chicago; [illegible] ecial agent American Bell [illegible] J. P. Barrett, [illegible] Morgan, gen[illegible] company, [illegible] Pittsburgh [illegible] nnati; Major J. C. Hall, [illegible] innati; [illegible] Chicago; J. E. [illegible]; H. H. Matlock, di[illegible]

ern Electric company; C. H. Wilson, general superintendent Chicago Telephone company; F. G. Beach, general superintendent Central Union Telephone company, Chicago; R. C. Wetmore, secretary and treasurer Chicago Telephone company; W. S. Chapman, secretary and treasurer Central Union Telephone company, Chicago; J. F. Wallack, Indianapolis, Ind.; A. M. Day and John Hinchman, Chicago.

The Electric Blowpipe.[1]

BY SAMUEL SHELDON, PH.D., PROFESSOR HARVARD UNIVERSITY.

The application of dynamo-electric currents for the welding of large pieces of metal in the mechanic arts has been practically demonstrated as a success. But its employment has been of necessity limited to large workshops, where the amount of work of this character would warrant the purchase of a dynamo. Furthermore, the danger attending the use of powerful currents has deterred many from making use of them, because they have had in their employ mechanics of only ordinary attainments, with no especial knowledge of electricity.

Besides the Thomson-Houston system, which employs a current of very great strength but small electromotive force, and where the pieces to be welded are brought into contact, two general methods employing the electric arc have been used. The first consists in making an electrode of each of the pieces to be welded, a small space being left where the welding is to take place. If a strong current be sent through, it forms an arc of great heat at this space and the metals are melted, and, running together, form a compact whole. The second consists in connecting both of the parts to be welded to one end of the circuit, while the other end is connected to a movable point, which is brought into close proximity to the joint, and, the arc being formed, gives the same result as before.

For many pieces of work these methods are not practicable. For instance, oftentimes when two pieces are brought into their proper relative positions, if a current be sent through after the first method, arcs will be formed at several places, and junctures will be made in places not desired. Again, in the employment of the second method, the use of two hands is often essential in the manipulation of the work, in which case a second person is necessary to apply the second contact. It is well known that two persons cannot co-ordinate their movements in the efficient manner in which one can those of his two hands, and the result is often an inferior grade of workmanship.

Now, the peculiar behavior of the electric arc, when placed in a strong magnetic field, affords at once a simple and efficient means for welding. A dynamic attraction or repulsion occurs between the rectilinear current of the arc and the amperean currents of the field, and this results in the drawing or driving out of the arc into a point, which is very similar to the point of flame projected from a blowpipe. The form may be seen from the following sketch:

The heat at the point of the arc is intense, and suffices to melt any of the metals. A piece of number 14 copper wire held at the apex melts instantly.

This extreme heat in such a convenient form can be the means of bringing electro-welding within the reach of all shops where arc lamps are employed for illumination. By a mere nominal alteration the lamp may be made to perform the double function of illumination and welding. To attain this end a straight electro-magnet wound with coarse wire is only necessary. This is placed with one end toward the arc, and may be fixed in one position (to be determined by experiment, and depending upon the direction of the desired point of the arc), or made movable in a horizontal plane on a level with the arc. The two terminals of the magnet coil are inserted anywhere in the main circuit, or, if found necessary, may be shunted from the same. The connections, once made, can remain undisturbed, and [illegible] the main line, the lamp performs its two functions.

In the [illegible] of the arc for electro [illegible], of course, wear col[illegible] for the protection of the eyes.

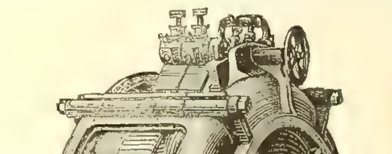
Care must be used in the selection of these, for some of the coloring matter used (especially in blue and red glasses) absorbs the light given out at the apex of the arc, and this would be detrimental to fine work.

The electric arc, when in a strong magnetic field, exhibits another peculiarity. It is known that if a circuit, traversed by a strong current, be broken under ordinary circumstances, a moderate spark will ensue, accompanied by a snap similar to that given by a toy cap when exploded. If, however, the break be made in a strong magnetic field, an extremely large spark follows, accompanied by a peculiarly sibilant report as intense as that of a pistol. The effect is very startling when unexpectedly made.

If a strong field be brought to bear upon the interrupter of the primary circuit of a Ruhmkorff coil, the spark emitted by the simple secondary coil equals in magnitude and length that which would be produced under ordinary circumstances were the secondary in communication with a large condenser. This simple means may often be employed to advantage in work with a Ruhmkorff when a large spark is desirable, and, at the same time, any electrostatic residue, owing to the condensers, is to be avoided.

Wheel Armature Dynamo.

The accompanying cut illustrates a wheel armature dynamo recently patented in Germany by W. Fritsche of Berlin. In the description of this new generator the London *Electrical Review* says: The number of new dynamos appearing yearly is extremely great—so great that we cannot possibly expect to find that all those novelties are, at the same time, improvements. The dynamos which at present can really be called good are almost all constructed on the old well-tried types of a few firms. It is natural that these machines have been improved in the course of years. Their construction shows undeniable improvements, which appear both in an electrical point of view and in manufacture. But as regards novel dynamos which are almost all variations of known models of ring or drum machines, they can scarcely be recognized as any advance, or any step toward original construction. The want of real improvement is scantily marked by the refined devices which are cherished in the arrangement of the armature coilings and the consequent complicated structure of the commutators as well as by arrangements of the magnetic field in the recent construction of dynamos, often not easily explained. By the present craving to produce simply something new we have remained so far behind that the



WHEEL ARMATURE DYNAMO.

construction of dynamo machines cannot lay claim to the name of machine building. It cannot, however, be denied how great are the disadvantages which thus arise. The rapid spreading of the technics of electric lighting is devoid of a natural basis so long as we have no construction of dynamos which is sound theoretically and practically. This weak point in our modern technics is rarely recognized, even among specialists, as is daily proved by new undertakings both in the field of electro-metallurgy

and in electric lighting, both dependent on the construction of dynamos.

As some excuse for this, however, we will admit that we should not have handled so ruthlessly the above-mentioned defects if we had not been brought by facts to the conviction that the first great step toward amendment has been taken with the construction of the wheel armature dynamo (Fritsche's patent). The machine shown in the cut is at first glance very little different from well-known types. It appears as a variation of the multipolar disk machines.

We are therefore tempted to suspect that the patentability of this machine, as of so many others, lies in some unimportant nicety. Such, however, in fact, is not the case, for the German patent is for the peculiar construction of the armature of the machine. In the title we have called the machine, as do the firm which constructs it, the wheel armature dynamo. This name gives us the desired clue to the constructive specialties of the machine.

The wrapping claimed owes its origin to the attempt at simplifying the drum armtaure wrapping. It culminates therein that by the introduction of single rods its execution has become possible on the covering of a cylinder without utilizing the front surfaces.

It is not intended to discuss the immediate advantages of this wrapping for the construction of drum, or rather cylinder armatures, but to treat of the eminently far-reaching import which the transfer of the plan of wrapping of the cylinder to the disk, or, better, wheel armature, has effected. The wheel armature, as carried out in the machine, owes its origin to the new method of wrapping. The constructor calls the armature not a disk, but a wheel, for according to the patent specification it is possible to construct this armature without core, without cotton insulation, without copper, and without any peculiarly arranged commutator, and in this point culminates the important advance of the improvement. The wheel armature is incombustible, and takes the form of a grating of fine wrought iron rods, separated from each other by the best insulating material, that is by air. Organic insulators, which are liable to become charred or even burnt, have been entirely dispensed with. Thereby, by the peculiarity of the wrapping, no complicated introduction of rods and no connection with a peculiar commutator are necessary, but the rods of the wrapping are continued as commutator segments. It is important that the armature for any given number of poles gives off a current at two points only.

Each word which we have used in characterizing the wheel armature opens out a prospect hitherto unimagined, on to the new construction of dynamos. The avoidance of insulation with cotton for the armature, and, indeed, of organic matter altogether for the insulation of the electric conductors of which the armature is composed, must reconcile every mechanician to the dynamo, and satisfy every electrician concerning the utilization of the iron wires, the magnetic resistance which copper presents, and which hitherto seemed to stand in the way of disk machines, is obviated.

We add to our brief report that we have here to do with an interesting experiment, and that the complete machine (a relatively large type) is already at work, and justifies the most sanguine anticipations.

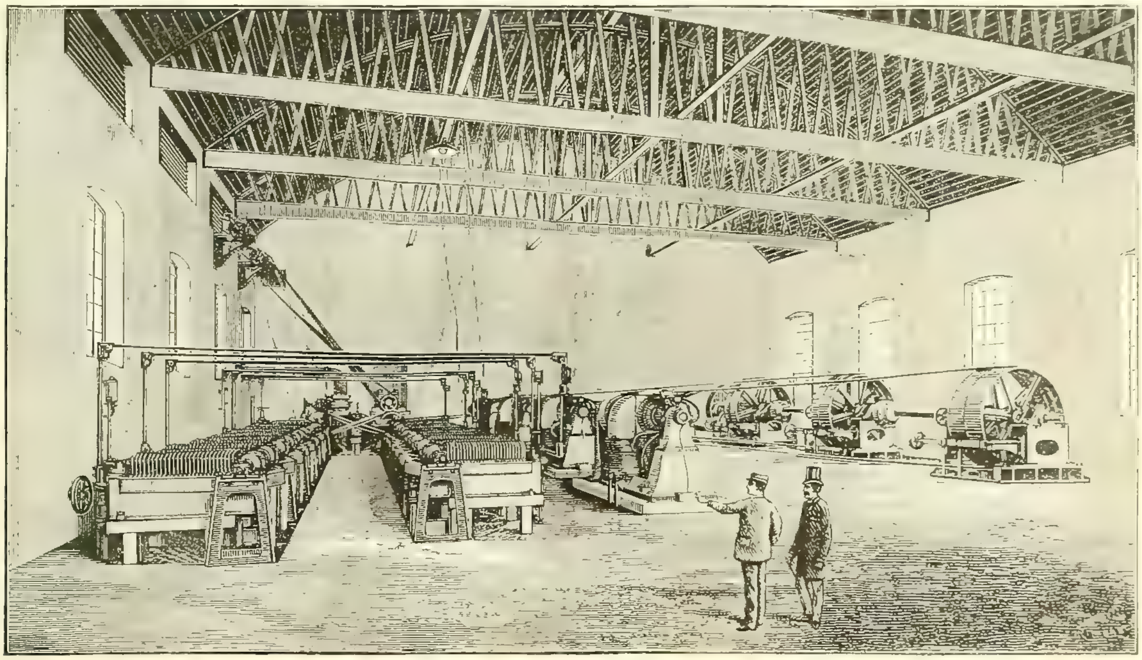
The firm Fritsche & Pischon, founded a year ago, has in this short time overcome all the difficulties of construction encountered in building a machine which deviates so completely from all established precedents. The firm is now entering upon the construction of such machines upon a large scale.

The Hermite Electro-Chemical Bleaching Process.

The accompanying illustration represents the arrangement of the plant for the Hermite electrical bleaching process, lately installed at Evans & Owen's paper works, near Cardiff. The plant is capable of producing equal bleaching effect to two tons of bleaching powder per twenty-four hours, and was constructed and installed by Paterson & Cooper to the order of the Hermite British Electro-Bleaching company, says the London *Electrician*. Briefly described, the Hermite process consists in manufacturing a solution of high bleaching power by electrolyzing an aqueous solution of magnesium chloride. The salt is decomposed by the current at the same time as the water. The nascent chlorine, liberated from the magnesium chloride, and the nascent oxygen, liberated from the water, unite at the positive pole, and produce an unstable oxygen compound of chlorine of very high bleaching power. The hydrogen and the magnesium go to the negative pole; this last decomposes the water and forms magnesium oxide, whilst the hydrogen is disengaged. If in this liquid colored vegetable fiber is introduced the oxygen compound acts on the coloring matter, oxydizing it. Chlorine combines with the hydrogen to form hydrochloric acid, which, finding itself in the presence of magnesium in the liquid, combines with it, and forms the initial chloride of magnesium. Thus a complete cycle of changes goes on so long as the electric current acts on the solution in the presence of coloring matter. The cycle is a perfect one, in which there are four elements—the electric current, chloride of magnesium, water, and the coloring matter. Only two of these elements are used up while bleaching—the electric current and the water. The magnesium chloride serves over and over again. There is only a simple displacement of molecules, and the chlorine acts as a vehicle to discharge the [illegible] results.

[illegible] connected to the negative pole of the dyn[illegible] the perforated pipe, and overflows the sid[illegible] decomposed, then falls into a cement tank underneath. From this bottom tank it is taken by means of a 12-inch centrifugal pump into the tank above [illegible] electrolyzer again, according to the strength required. The top tank is a large, egg ended boiler, and is connected to each electrolyzer by means of a rubber pipe and cock.

It is from the top tank that the solution is pumped over to the bleaching mill, a distance of some fifty yards, by means of an 8-inch centrifugal pump, where it is received in tanks, from which it is drawn as required. The method of working is very simple; the pulp ready to be bleached being in a "potcher," the electrolyzer bleaching solution is run in, and the washing drum kept working; as the solution passes through the pulp its bleaching power is exhausted, and it is returned by means of a pipe to the top tank from which it originally started, and whence it again passes through the electrolyzer, and is regenerated.



HERMITE ELECTRO-CHEMICAL BLEACHING PROCESS.

The amount of solution remaining in the pulp after bleaching is recovered by a system of displacement in drainers, or by means of a press plate.

The current is supplied by three of Paterson & Cooper's Phœnix shunt wound dynamos, [illegible] giving a current of 1,000 to 1,200 amperes, with a difference of potential at the terminals of [illegible] volts. The electrolyzers are arranged in series, eight on each of two dynamos and four on the other; this has been so arranged that another four may be added when required. [illegible] has an ammeter and voltmeter [illegible]. The dynamos are driven by a [illegible] engine of the tandem type, capable of indicating 300 horse power, the amount actually taken up at present being 200 horse power.

An important part of the plant is that for the preparation of the magnesia necessary for keeping the solution basic. It consists of a vertical tank fitted with a stirrer, in which [illegible]

[illegible] into a chute, discharging into any one of three vertical tanks, each fitted with a stirrer. These tanks are all placed above the main tank supplying the electrolyzers, so that by merely opening a cock the "base," when prepared, can be run down at will. The three vertical tanks are partly filled with a solution of magnesium chloride, and then filled to the top with the lime milk. The lime throws down the magnesia, the calcium chloride which remains is siphoned off, the magnesia being then washed twice, is ready for use.

The cost of bleaching by this system compares very favorably with the old process. The fibers bleached are not deteriorated in strength to anything like the same extent as with bleaching powder.

There are many modifications of the process for the bleaching of linen and cotton yarns, piece goods, etc., and also many different forms of apparatus, which are the subject of numerous patents in the names of Messrs. Hermite, Paterson and Cooper, in England and abroad.

This process has been adopted on a large scale by several important paper makers, some of whom, after prolonged trial upon a limited scale, have given extensive orders.

Perret Electric Motor.

A great deal of attention has been devoted within the last two years to the improvement of small motors. Results of an eminently satisfactory character have recently been attained. The Perret electric motor was put on the market in 1886, and gave excellent results. Since that time it has been greatly improved, and the new machine which has been put on the market by the Elektron Manufacturing company of Brooklyn, N. Y., is claimed to be of great efficiency. The motor is designed for constant potential circuits or may be operated by batteries. Six sizes ranging from $\frac{1}{8}$ to $1\frac{1}{2}$ horse power are now made. The smallest size gives, it is claimed, over 70 per cent. commercial efficiency, and the percentage increases as machines increase in size, reaching over 90 per cent. in the $1\frac{1}{2}$ horse power size.

The field magnets are built up of thin plates stamped out of soft refined sheet iron of the highest magnetic permeability secured in planes at right angles to the armature shaft. All wasteful induced currents are thus prevented, and a magnetic circuit of the best character is secured. The armature core is also laminated and carefully insulated, and where, as in the smaller sizes, saving of space is important, double silk covered wire is used. The constant speed motors have the simple shunt winding which, with armatures of very low internal resistance, give close automatic regulation together with high efficiency.

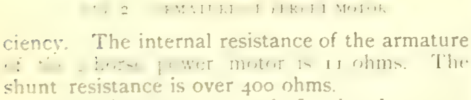


FIG. 2. [illegible] PERRET MOTOR.

The internal resistance of the armature of the [illegible] horse power motor is 11 ohms. The shunt resistance is over 400 ohms.

The bearings are accurately fitted and are very [illegible] n proportion to their diameter. In the two smaller sizes they are of hard composition and in the larger of Babbitt metal. The shafts are of steel ground on dead centers. The armatures are of the drum type. The wires on the armature are as short and thick as possible, and the [illegible]. The commutators which [illegible] wear and to damage through [illegible] received particular attention. They are of hard bronze, carefully insulated, and [illegible] proportioning the [illegible] there is no dis[illegible] the brushes do [illegible] of load. All [illegible]. The armature is so supported that perfect alignment [illegible] regard [illegible] the iron plates.

[illegible]

Electric Motors in Chicago.

The introduction of the electric motor for the distribution of electrical energy was one of the most important steps in the scientific world. The invention of the motor opened an entirely new field for electricians, and it has proved one of the most important and extensive that has thus far been discovered. By means of the motor natural resources of undeveloped regions have been utilized. In no other part of the country is this so true as in the west. As a means of distributing power it is unequaled, and from an economical standpoint it cannot be surpassed. But it is wholly unnecessary to dwell further on the many points of merit in electric motors. They

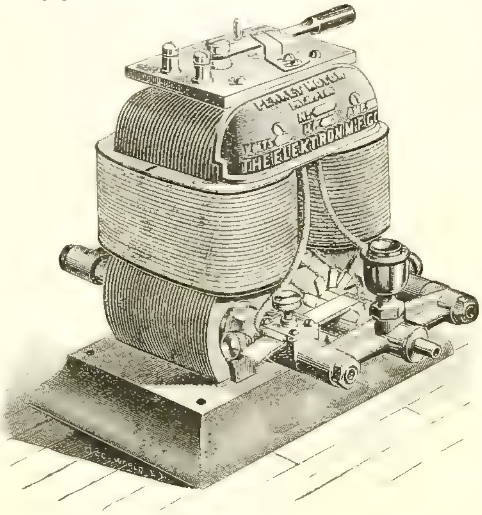


FIG. 1. ONE-SIXTH HORSE POWER PERRET MOTOR.

are too well known to require enumeration here. Although the introduction of electric motors on an extensive scale in Chicago has only been done recently, the experimental stage has long since been passed, and eastern manufacturers have regarded the motor as an all-important factor in the problem of power. There is a novelty about the use of electricity for manufacturing purposes that is highly attractive. It is interesting to visit a factory in which steam is utilized, and watch the numerous machines in motion, and trace the power to its source from the top floor to the engine room, but it is far more wonderful to enter a factory in which the machines are operated by electrical energy. Here the machines revolve and do their work the same as in the other building, but a visitor is unable to see whence they get their power. In a great many instances the motor is cheaper and it is always cleaner, and there is a saving inthe wear and tear of machinery, belting, etc. It is only within the last year, however, that the manufacturers of Chicago have learned the benefits to be derived from the use of the electric motor. Before that a few motors had been introduced to operate fans for ventilating purposes, but it was not until a year ago that the motor was utilized for driving heavy machinery. The Baxter Motor company at that time undertook to introduce its machine in Chicago, but its representative, W. W. Munroe, found at first that there was considerable prejudice to overcome. The city authorities did not wish to permit the motor to be run in connection with an arc circuit, and it required elaborate arguments and the citation of numerous examples before their fears could be overcome. Charles E. Marble of 165 Madison street, has the distinction of being the first printer in Chicago to adopt electricity for the operation of his presses. During the year, however, many other printing houses have introduced motors, and those of the Baxter pattern can be found in the following establishments: McClellan & Greamer, 116 Fifth avenue; Parker & Chapman, 73 Randolph street; Peter Johnson & Co., 172 Clark street; A. L. Canfield, 118 Randolph street; K. Flanders & Co., 112 Fifth avenue; [illegible] Bros., 112 Fifth avenue; [illegible] Bros., 166 Washington street; Robert [illegible], 66 [illegible] street; H. H. Bagnoll & Co., 166 Washington street; Charles Dowsh, 195 [illegible] street; Chicago *Daily Herald*. This [illegible] a small percentage of the total number of Baxter motors introduced in this city. They are utilized in 18 different classes of establishments, including clothing houses, shoe houses, etc. They are also used for elevators, operating fans in stores, offices and manufacturing establishments, where large numbers of men are employed. Among other prominent establishments in which the Baxter motor is used are the following: John B. O'Dell, electrician, 175 Washington street; S. F. Cone Shirt company, 191 Clark street; Charles Essig, 125 State street; L. C. Wachsmutt & Co., clothing, 246 Madison street; William Whitley company, harvesting machines, Lake street; Common Sense Truss company, 58 State street; New Haven Sewing Machine company, 248 Washington street; Roovert Bros., jewelers, 155 State street; C. H. Wehrstedt, manufacturer of jewelry, 113 Madison street; C. W. Pardridge & Co., Boston Store, 118 State street; N. B. Haynes, millinery goods, Wabash avenue and Madison street; Geneva Optical company, 57 Washington street; Frank A. Colburn Optical works, 125 Dearborn street; M. J. Fitch Paper company, Randolph and Franklin streets; W. E. Morgan, hat store, 182 Wabash avenue; Dr. A. Owen, electric belts, 191 State street; Parisian Shirt company, Pullman building; John Sexton, coffee merchant, 20 State street; Fred Meyer & Bros., clothing manufacturers, 234 Franklin street. Mr. Munroe has extended his operations to Milwaukee, St. Paul, St. Cloud, Minn.; Grand Rapids, Mich.; Denver, Col., and many other western towns.

The Sprague Electric Railway & Motor company of New York has also established the headquarters of its western business in Chicago, and has been highly successful. C. M. Barclay personally superintends the motor department, and from him many important facts were elicited by a representative of the WESTERN ELECTRICIAN. The wide range of uses to which the motor is put can be illustrated no better than by the statement of Mr. Barclay that elevators were run, ventilating fans operated, power furnished machinery of all kinds, printing presses, etc., and ashes hoisted from the cellars of large buildings to the alleys, where carts were in readiness to receive them. The Sprague motor is in great demand by printers, and those in use for operating presses range from 2-horse power to 25-horse power. Rand, McNally & Co. have a 25-horse power motor of this pattern driving the machinery on their three floors. One large printing establishment in Chicago recently introduced a 10-horse power motor, and was so well satisfied that it has been decided to run all

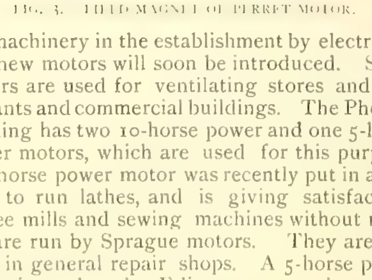


FIG. 3. FIELD MAGNET OF PERRET MOTOR.

the machinery in the establishment by electricity, and new motors will soon be introduced. Small motors are used for ventilating stores and restaurants and commercial buildings. The Phœnix building has two 10-horse power and one 5-horse power motors, which are used for this purpose. A 2-horse power motor was recently put in a gun shop to run lathes, and is giving satisfaction. Coffee mills and sewing machines without number are run by Sprague motors. They are also used in general repair shops. A 5-horse power motor is used at the Edison company's station to hoist ash buckets from the furnaces to the wagons in the alley. At present the company is putting in a 15-horse power motor to run a passenger elevator in a large building. One of the most interesting installations made by the company was in the *Tribune* office. It was described in the last issue of the WESTERN ELECTRICIAN. Mr. Barclay says the outlook in the motor business in Chicago is improving daily.

The C. & C. company's western agency has its headquarters in Chicago, and has succeeded in establishing an excellent reputation for its

special style of motors. These are used principally in operating sewing machines, ventilating fans, and driving various kinds of light machinery. Heretofore special attention was given to the introduction of small motors, but since the company took possession of its new quarters in New York city it has decided to put larger motors in the market, and a special line is now being introduced. Manager Armour of the western agency is pleased not only with the progress already made by his company, but also with the outlook. He believes the people of Chicago have not yet fully awakened to a realization of the great benefits to be derived from the electric motor, but they are being educated rapidly to that point.

There are many other motors in use in Chicago, and new patterns of machines are being constantly presented for public approval, but the experience of the companies cited, and the success which has attended their efforts, are sufficient illustrations of the progress made in the metropolis of the west.

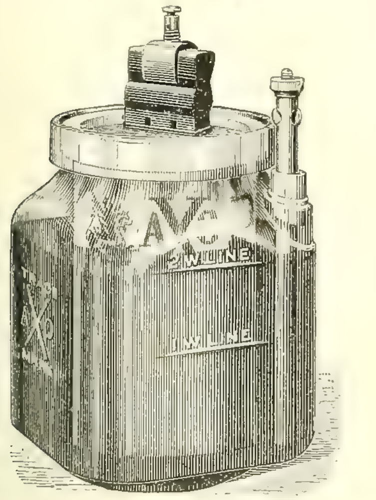


FIG. 1. AXO BATTERY, WITH JAR ADAPTED FOR SEALING HERMETICALLY.

National Electric Light Convention.

B. E. Sunny, chairman of the executive committee of the National Electric Light association, states that the floor space at the disposal of the committee for exhibition purposes has practically all been taken, and there will be great difficulty in arranging accommodations for additional applicants, unless they are willing to come out in the main hall of the building, where there is no heat. So far forty-six distinct exhibits have been arranged, and the locations settled upon. The exhibits embrace electric railways, electric welding, arc and incandescent systems (the latter direct and alternating), motors of all sizes and styles, switches, indicators, and the innumerable necessary appendages of an electric installation; a great variety of insulated wire, embracing all of the standard makes; supplies of every description, engines of the best types in operation, steam gauges and safety devices, new ideas in belts, clutches, etc.; non-magnetic watches, magnetic shields, new designs in electroliers, and glassware for electric light fixtures; mast arms; arc lamp adjuncts; stone crushers operated by motor, steam pipe covering, underground conduits, etc. An enterprising supply house in Chicago has undertaken to furnish a fence around each exhibit, made of insulated posts and wire.

Preparations are now being made for the reception and placing of the exhibits, and it is hoped that the entire exhibit will be in good running order by the 15th. Exhibitors at a distance from Chicago should ship their goods so that they will arrive by the 10th at least, so that ample time may be had for their proper disposal. Shipments should be made to the Electric Light Convention, Exposition Building, Chicago. The work of arranging the exhibits and attending to the many minor details has been intrusted by Mr. Sunny to Fred W. Bossam of the Thomson-Houston staff of engineers. Admission tickets to the exhibit will be furnished to exhibitors for distribution among their friends and correspondents by application to Mr. Sunny, at [illegible] Michigan avenue. As before stated, there will be no admission charge.

Among the exhibits will be a Detroit storage battery plant, in combination with a gas engine and dynamo. The battery will run incandescent lamps and motors.

The Axo Battery.

The accompanying cuts illustrate an improvement in porous cup batteries. The new battery, which is put on the market by the Leclanche Battery company, is called the Axo.

The porous cup forms of itself a cover for the cell, closing it completely, and preventing the escape of salts or liquid. The zinc passes through an independent aperture in the shoulder of the jar, which is also closed by a rubber stopple. The carbon conductor, instead of being straight, is conical or pyramidal in shape, its sides inclining outward toward the bottom and forming inclined planes, against which the particles of the surrounding mixture press, constantly, by their own weight. A contact by gravity is thus secured, which, being automatic, is maintained at all times, and under all conditions, and is never irregular and faulty, as is so often the case in the old forms. The ventilation of the cup is accomplished by means of deep grooves in the sides of the carbon, running along its whole length, from the bottom through and above the sealing material. This is a far more efficacious method than the old one, of piercing holes in the seal. Through these grooves the gas bubbles forming on any part of the carbon are provided with ready channels of escape, and consequently the depolarization of the element is greatly accelerated. The connection for the carbon is a metallic clamp and thumb screw, which can be removed and replaced in a moment. The peculiar shape of the jar at the bottom serves several purposes. The well in the middle keeps the bottom of the porous cup in place, and the ridge of glass surrounding it separates the cup and the zinc rod. On the outside the same well forms a depressed bottom for the cell, while the sides of the jar are raised above the level upon which it rests, and are kept free from contact with the dirt and spilled salts which collect and creep up the sides of the ordinary jars and foul the battery. The cell can be hermetically sealed without the slightest difficulty by pouring a little melted paraffine into the space between the flange of the cup and the rim of the jar, being at the same time careful not to let the wax come high enough to stop up the ventilating holes at the sides of the carbon. The advantage of sealing with paraffine is that the cup can be taken out at any time by heating the

FIG. 2. AXO BATTERY—POROUS CUP.

paraffine, or running a knife blade around between the flange of the cup and the rim of the jar. A jar is also furnished, as shown in the cut, in which the flange of the porous cup rests on the top rim of the jar instead of on a shoulder inside. This closes the jar sufficiently tight for all ordinary purposes.

The California Electric Light Company is installing two Brush dynamos at San Diego to furnish arc lights for public purposes.

Storage Batteries for Street Car Propulsion.

[illegible] the maintenance of horses. [illegible] has frequently run a distance of twelve miles, carrying over 200 passengers [illegible] power-hours of energy."

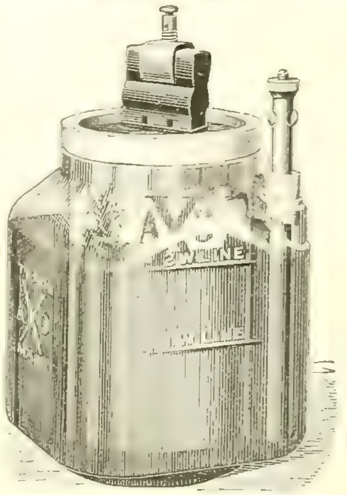


FIG. 3. AXO BATTERY [illegible]

Electric Light in the South.

The list of Southern industries originating in 1888, published in our issue of the 10th inst., shows that twenty-seven new gas companies and 122 electric light companies have been established during the year, says *Light, Heat & Power*. During 1886 the figures stood: Gas companies, twenty-four; electric light companies, thirty-four—a surplus of 40 per cent. in favor of the latter. In 1887 there were thirty-five gas companies and eighty-three electric light companies, a surplus of 137 per cent., and a gain in percentage over the ratio of the previous year of nearly 100 per cent. Last year, as given above, we have a surplus of more than 350 per cent., and a net gain of 213 per cent. over the figures of the previous twelve months. Again, between the figures of 1886 and 1888, the gas projects show a gain of but 12 per cent., while the electrical projects show a difference of more than 250 per cent.

Proposed Underground Railway in London.

The projected electric underground railway in London is by no means to be allowed to go on unopposed. The railway is needed and would be of great public advantage. The motive power contemplated being electricity, no objection on the ground of steam and unpleasant gaseous exhalations can be raised, therefore the bill is to be opposed as dangerous. The secret of the objection is to be found in another direction. Knowing what can be done to support buildings over subways the promoters do not propose to buy up the property along the route, but simply to bore underneath, underpinning where necessary, and, of course, compensating for damage to private property. Thereby the tradesmen and owners will lose the chance of obtaining fabulous sums such as railway companies frequently have to pay, and for this reason it is that the bill is opposed.

Electric Motor Road for Philadelphia.

The Philadelphia *Public Ledger*, among other large and influential papers, has devoted considerable attention in both its news and editorial columns to electric roads. In commenting on the West End road of Boston, which was installed by the Sprague company, it questions why a system which has proved so successful in this latter city could not be introduced to supplant the slow horse car in Philadelphia. On account of its capacity for speeding an electric car, for the same hours of service, should make about twice as many miles per day as an ordinary horse car, and owing to the remarkable control which the operator has over the motion of the car, it can be stopped much more quickly. Even when running at twice the speed it is much more safe and less liable to collisions with any obstruction on the track than an ordinary horse car. There is no reason why electric cars should not be introduced into all the large cities like New York, Philadelphia, Chicago, St. Louis.

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W. A. K[illegible], - - - Editor and Publisher
J. W. D[illegible], - } Associate Editors
J. B. O'HARA, - }
A. C. [illegible] JR. - - - - Business Manager

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electricians, thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged

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THE Chicago Electric club has not yet finished its consideration of the question of insulation. At the last meeting Alexander Thompson read a paper on thickness of insulation, which appears in this issue. The subject was treated in a thoroughly practical manner.

THE exhibits at the convention of the National Electric Light association will constitute a noteworthy feature of the gathering. Substantially all the space reserved by the executive committee for exhibits has been spoken for, and the work of putting these in position will soon commence. The literary portion of the convention, at which the committee is hard at work, will be unusually interesting and valuable. The February meeting promises to be the most significant in the history of the association.

[illegible] becoming popular in Chicago for [illegible] purposes, and an article is [illegible] treating somewhat in detail of the rapid extension of the service in [illegible]. During the last few months there has [illegible] of a larger capacity [illegible] in the city. It is [illegible] that during the next few months a con[illegible] for motor work [illegible] which have been [illegible] great satisfaction [illegible] the [illegible].

[illegible] week [illegible] The

horses must be fed and cared for. With an electric road, however, the cars can be housed, the plant can be shut down, so that the operating expenses almost cease. This fact constitutes a decided advantage in the electric system, which must appeal to street railway managers in all great cities. The convincing argument, however, is that which has reference to the relative merits of the two systems in operation. When the comparison is made the superiority of the electric road from all points of view is apparent.

THE question of utilizing the immense water power of Niagara has occupied the attention of many able engineers, and numerous schemes have been proposed for the purpose, but their practicability has not been demonstrated. It would require an immense fortune to test the feasibility of these schemes, and even the great inducement of large returns in case of the successsful development of the plans, has not induced capitalists to invest their money in these enterprises. It is reported, however, that there is a fair prospect of testing one of the proposed schemes. C. B. Bartlett of Chicago has devised a modification of the old scheme for utilizing the power by operating dynamos. The current, he thinks, can be distributed economically. He has succeeded in interesting many prominent capitalists in the project. His plans are patented and he is now endeavoring to secure from the legislature of New York authority to proceed with his work. Should he gain permission, his operations will be watched with a good deal of interest by electricians throughout this country and Canada.

IN his inaugural address before the Institute of Electricians in London last week, Sir William Thomson incidentally referred to the fact that the professions of civil engineering and electrical engineering were in many respects closely allied. He said: "When, fourteen years ago, I gave my inaugural address, I endeavored to impress upon engineers and architects that architects made a great mistake in not being engineers, and in not qualifying themselves as engineers, and doing the work of engineers; that architects did not do their duty to their clients in not being engineers and understanding the engineering of their own works and making engineering science, particularly the dynamics of engineering, an essential part of the training of an architect. It is not necessary to make any animadversion on electrical engineers. I think in this respect electrical engineers know well that they must, before all, be engineers; they must be engineers, and they must learn engineering. Young persons who have a taste for electrical machines think they would like to be electrical engineers, and they think that electrical engineering is all ether and electricity. Now I have continually to impress upon many anxious parents that their boys must condescend to learn something of gross ponderable matter; that electrical engineering is not all electricity and ether, but that ponderable matter is also part of the subject.

"The youthful aspirant to the honorable profession of electrical engineering ought to learn mathematics and dynamics; after having the elements of a good general education, he ought to learn mathematics and dynamics well, then a good deal of chemistry and regular mechanical and civil engineering, besides electricity."

THE underground system of the Chicago city electric light plant has thus far worked admirably. A few temporary splices have been overhauled, and the insulation in a few points has been improved, but no trouble has been experienced. The test of the system will be during the rainy weather in the spring, but the operation has thus far been so satisfactory that no trouble is experienced.

The success of the city electric light plant of Chicago, is so manifest that the aldermen are using every means in their power to extend the plant. It is probable that an appropriation of $[illegible] will be made for the immediate extension of the system. Alderman Wetherell's scheme to have the city go into oil lighting for outlying districts will enable the city, it is claimed, to save $25,000 to $30,000 annually, and it is proposed to use this sum in extending the electric light system. At this rate the entire city will soon be lighted by electricity, and Chicago will be able to boast of having the greatest, as well as the first, underground system for public lighting of any important city in the world.

The Medico-Legal society of New York, whose meetings, in which electric executions formed the topic under consideration, have been reported in these columns, has issued an appendix to the original report of its committee. The supplement states that experiments have led the members to emphasize the advisability of employing the alternating current in the infliction of the death penalty. The committee renews its recommendation as to the mode of applying the electrodes.

BY the death of George L. Phillips the Chicago Telephone company loses a president of marked ability as an executive officer. He was recognized as one of the most judicious and efficient telephone managers in the country. He was at the head of the corporation but a little over a year, but during that period arose the vexatious controversy between the company and the city officials. There was an extremely bitter feeling in the city council toward the company, and it was hampered in its business by threats of litigation, and prevented from extending its circuits by the refusal of the aldermen to grant a franchise. Repeated efforts were made to force on the company ordinances which would have reduced very seriously its income. The responsibility of adjusting these difficulties fell upon Mr. Phillips. The task was one which required in its execution all his skillful management. He solved the vexatious problem, and secured a franchise without conceding any of the points for which the company had been contesting. This victory gained for Mr. Phillips the hearty congratulations of telephone managers throughout the country, and added materially to his reputation as a vigorous executive officer. He lived but a short time after the accomplishment of this important work. The circumstances of his death were unusually sad. The particulars are given elsewhere.

IT is probable that a new telephone bill will soon be presented for the consideration of the Illinois legislature. The authors are Senator Eckhart and Representative Baker. In cities of 25,000 population and under it is proposed to make the monthly rate $3; in cities of 50,000 and under, $4; and in all cities of a greater population, $6. This would make the rate in Chicago $72 per year, a reduction of $53 on the rental of each instrument. The Chicago company has anticipated a measure of this kind, but does not fear its passage.

The committee of citizens which examined the books of the company operating in Kansas has come to the conclusion that the rates against which so much protest had been made were by no means exorbitant. The committee went further, and asserted that the company was not making as much money as it should do. The decision of the committee was reached after a careful examination of the company's books. The tendency to interfere with the operation of telephone companies is spreading. Within the last week measures aimed at telephone corporations were introduced in the legislatures of Michigan and Minnesota. In the former state the proposed bill contemplates a general reduction of rates; in the latter state increased taxes are put upon telephone companies in a measure which has been introduced.

The organization in New York which has been formed to wage war against the telephone companies of the state has entered upon a vigorous campaign, according to the correspondence from New York. Perhaps attention should be called in this connection to an interview with the manager of the Cincinnati exchange, which appears in the correspondence from that city. The sentiments which he expresses are probably very nearly identical to the views of most telephone officers who see before them the prospect of legislative interference.

Paiste Incandescent Switch.

A switch for incandescent work, designed by H. T. Paiste of Philadelphia, Pa., is illustrated in the accompanying cuts. The entire switch is stamped from sheet brass by standard dies, and all parts are interchangeable. The switch consists of seven pieces—the U-shaped main shell, side plate, two arms, spindle, spring, and hard rubber handle. The spring is attached to the ends of two arms, and is extended when the switch is operated to make or break circuit. When this is effected the spring is no longer under tension. The circuit wires are attached to the bending screws on the main shell and side plate. The arm shown in Fig. 2 completes the circuit between the side plate and main shell and through the spindle upon which it is centered, making ample electrical contact. The arrangement is such that whatever arcing might result on breaking the circuit would be on the back of the arm and not on the face where electrical contact is made. An improvement has been made in the handle. If turned backward it will simply unscrew, and straining of the working parts is avoided.

Electric Lighting in the Naval Service.

The following facts concerning electric light plants on ships of the United States Navy are taken from the annual report of Lieut. Bradford, naval inspector of electric lighting:

The Trenton.—The plant of this ship, as described in my report of last year, has continued to perform excellent service. On one occasion the engine and dynamo were run fifteen days without stopping. The total number of

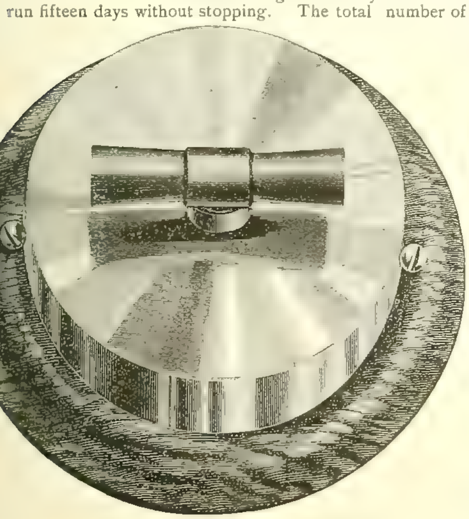


FIG. 1. PAISTE INCANDESCENT SWITCH.

lamps has been increased to 300, as follows: 193 of ten candle power, 101 of sixteen candle power, and six of thirty two candle power.

The Omaha.—This ship was originally installed early in 1885 by the Consolidated Electric Lighting Company of New York, with a shunt wound seventy-five volt and eighty five ampere Sawyer Man dynamo, a 9½ x12' Armington & Sims horizontal engine and 156 sixteen candle-power Sawyer Man lamps. Wire, insulated with paraffined cotton, and then covered with lead, was used. In many instances this was secured by using iron staples. The dynamo was driven by means of a counter shaft and belting. The three years' cruise of this ship terminated during the past year, and the general performance of her plant may now be briefly stated. Although the plant was generally run only from sunset to midnight, and there was a spare armature on board, the construction of the dynamo was so faulty that it was with extreme difficulty that it was kept serviceable for three years. The spindles of both armatures broke short off, and were repaired. The insulation of both armatures proved to be faulty A clever piece of work was performed on board under the direction of Ensign H. G Dresel, U. S. Navy, who had charge of the plant, in rewinding one of the armatures. The lamp sockets proved faulty in the switch arrangement for turning off and on. The lamp wires were exposed and sometimes corroded off The iron staples in many instances indented the lead covers of the conductors, and caused a leak The paraffined cotton proved totally inadequate as an insulator, and it goes without saying that with such an insulating substance a lead cover does more harm than good. The *Omaha* was re-commissioned at Panama for further service in China. A large amount of electric lighting supplies were purchased for her and shipped to that port. They consisted of a new seventy five volt and 128 ampere Thomson-Houston compound wound dynamo with spare armature, a large amount of rubber insulated lead-covered wire, new lamps, sockets, volt and ampere meters, testing generator, a Weston 2,000 candle power arc lamp, cut-outs, fusible strips, and numerous other small supplies. The old dynamo was shipped to New York; the new one was hoisted on board one night and in operation the next. * * From the first the dynamo has worked smoothly and given great satisfaction. The arc lamp has been used for lighting up the ship when coaling [illegible] the proper [illegible] and [illegible] interfere with the steadiness of the incandescent lamps in circuit.

[illegible] As stated in my report [illegible] year I have [illegible] inspected the plant of this ship [illegible] mentioned as the Bureau having cognizance of the [illegible] ing station. It has been learned from the quarterly reports made during the past year that there are installed a total of [illegible] lamps, [illegible] of sixteen candle power [illegible] thirty two candle power and seven of 100 candle power.

[illegible] The plant of this ship continues to give satisfaction, although heavy and occupying great space. Frequently it is run a week continuously. Faults occasionally occur from bad insulation and defective fixtures. The lamps now number 292, and are all sixteen candle power of the Weston type. They do not seem to be as long lived as some other types used in the naval [illegible] * *

[illegible] The plant of this ship as originally installed and described in my last report has not given satisfaction. The armature of the dynamo is of large diameter and has frequently chafed against the pole pieces, necessitating repairs, and even dressing down the pole pieces $\frac{1}{16}$". It has been found impossible to prevent considerable sparking at the commutator, and one set of brushes and commutator segments, used with the greatest care, will last only from six to eight weeks. The dynamo also heats too much to be fully efficient, when running with full load, and in this connection it may be remarked that the dynamo room is deficient in ventilation, the temperature in summer varying from 100° to 120° F. This high temperature has a very marked effect in decreasing the electromotive force of the dynamo. The faults that occur in the installation generally arise from defective insulation of the conductors, from the want of efficient water-tight junction boxes and switches and water-tight fixtures. The conductors used to install this ship and the *Atlanta* are deficient in insulation, and must be replaced in the near future. * * There are now a total of 269 Swan lamps on board, eighty one of eight candle power and 188 of sixteen candle power. This type of lamp gives great satisfaction both in length of life and illuminating properties.

Recently the Brush Company has removed the original plant of the *Boston* and substituted another of the following brief description: The dynamo is practically the same so far as its electrical dimensions are concerned, but it is hoped it will prove to be of better workmanship; instead of having a belt pulley on the end of the armature there is a compressed raw-hide pinion. The engine is of the Armington & Sims horizontal double-cylinder type, fitted with a cast iron geared wheel, which engages the raw-hide pinion of the dynamo The engine cylinders are 7"x5", and the gearing $2\frac{6}{10}$" to 1". The new engine and dynamo weigh about 3 500 pounds, and the old about 10,400 pounds. The deck space occupied by the new plant is 4' 3"x6' 6"; that occupied by the old 4' 3"x17' 5". This plant has not been running long enough to decide upon its value, though at present it is very promising. The double cylinder Armington & Sims engine promises well for driving dynamos. It is very light and compact; it runs very smoothly and without noise, and its automatic governor is very efficient.

The Chicago.—The installation of this ship has been completed during the past year. It consists of two Edison compound-wound dynamos of 105 volts and 160 amperes and two Armington & Sims horizontal single cylinder 12⅛"x10" engines. The dynamos are driven by short but very broad belts. The plant occupies a space of 20'x6' and weighs 18,300 pounds. It was the most compact and the best adapted for marine work of any that could be obtained at the time the contract to install the *Chicago* was made. * *

There are on board a total of 438 Edison lamps, made up of 121 of ten candle power, 303 of sixteen candle power, eight of thirty-two candle power, and six of fifty candle power. With the exception of the fixtures, the fittings of this installation are very complete, and of a superior character, and it is confidently expected that they will be very serviceable. The insulation resistance of the entire system is above 100,000 ohms.

The Yorktown.—The contract of Messrs. William Cramp & Sons, Philadelphia, Pa., for building this ship requires that she shall be lighted by electricity. The specifications for the installation were prepared in this office, accepted by the builders, and a contract made by them with the Edison United Manufacturing company, 65 Fifth Avenue, New York, to perform all work connected therewith, and furnish all supplies except the fixtures, the latter being made under my supervision by Messrs. Williams, Page & Co , 24 Beach street, Boston, Mass , in accordance with a contract made by that firm with the Messrs Cramp & Sons. This ship is supplied with two compound-wound dynamos, each of eighty volts and 100 amperes, two Armington & Sims double cylinder and double acting horizontal engines, each directly connected to its dynamo by means of a flexible coupling. The engines work at a sixty pounds' pressure and cut off at one-quarter stroke. * * *

All of the appurtenances of the installation are of the best quality, and much credit is due to Messrs. Cramp & Sons for obtaining the best supplies and material in the market. It is confidently expected that this installation when complete will be equal if not superior to any in the world.

The Baltimore.—Detailed specifications for the lighting plant of this ship have been prepared in this office and accepted by Messrs Cramp & Sons. They have, as in the case of the *Yorktown*, closed a contract with the Edison United Manufacturing company to install the ship. The plant will consist of two sets of dynamos and engines, each of the same voltage, but double the output of those for the *Yorktown*, with the possible addition of a third set later. The engines will be the same size as those for the *Yorktown*, but will work with a normal pressure of eighty pounds, cutting off at one quarter [illegible]

[illegible] Edison United Manufacturing company [illegible] New York [illegible] work and supply all materials. [illegible] with one eighty volt 200 ampere compound wound dynamo, making [illegible] revolutions per minute [illegible] Armington & Sims engine, directly connected [illegible] usual flexible and insulating coupling. The engine will be of the same pattern and size as those for the [illegible] having cylinders 7"x5", and working with a [illegible] pressure of sixty pounds [illegible] cutting off at [illegible] stroke. There will be a total of about 200 lamps installed.

Electric Conductors on [illegible]—My recommendation of last year concerning the proper supervision of the installation of all electric conductors on shipboard, for whatever purpose, is renewed. In accordance with this recommendation this office was asked to suggest the electric signal apparatus for the *Yorktown*, which was done, including therein a "slide steam whistle" for use as a signal for closing watertight doors The conductors for

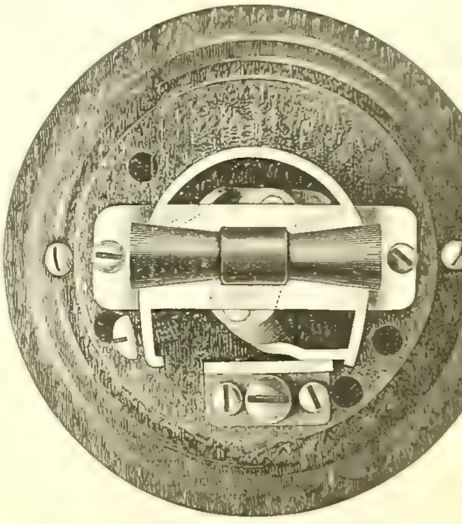


FIG. 2. PAISTE INCANDESCENT SWITCH.

the electric signal apparatus of the *Yorktown* were selected by me, and are insulated with rubber of excellent quality. They are being inclosed in wooden moulding where led about the ship, and therefore will be protected and accessible. The supervision of this work, as well as the selection of the signal apparatus, is performed by the resident electric light inspector, and the increased efficiency of the entire signal installation will be very great. It would be very advantageous for the ship if the search light, torpedo and gun firing wires were put up at the same time and under the supervision of the same officer, since he is not only an expert in the performance of this duty, but would keep all separate, a very important essential, and cause one to give way in space to another in accordance with the relative importance of each. The success of all electric apparatus very largely depends upon a careful attention to details, and the greatest difficulty by far that has ever been experienced with such apparatus on board ship is caused by faulty conductors badly installed.

Search Lights.—The Gramme search light plants of the *Trenton*, *Atlanta* and *Boston* are occasionally used for incandescent lamps at times when the incandescent plant is being overhauled By coupling the two Gramme dynamos in series they will maintain from forty to fifty sixteen candle power lamps continuously without overheating. By regulating the revolutions of the Brotherhood engine, the proper electromotor force, as indicated by the voltmeter placed in circuit, can readily be maintained. The *Chicago* has been installed by the Bureau of Ordnance with a search light plant similar to those above mentioned. The eighty volt compound wound dynamo adopted by the Bureau of Navigation in May, 1887, and now being installed in the new cruiser, as already described will, it is confidently expected, be very efficient for search lights Search lights are at times very useful, but discretion must be exercised as to when and how to use them. During the recent English evolutionary squadron exercises, the search lights of the blockading squadron failed to detect the escaping ships of the enemy, which had, of course, all lights out and everything visible carefully colored a dead black. On the other hand, the enemy's ships which were not trying to escape used their search lights to blind the eyes of the blockaders and interfere with the rays of their search[illegible] ers. Recent experiments in Russia indicate that it is not an easy matter to disable a search light with machine guns

[illegible] the light blinding the eyes and interfering with the aim It is found in Germany, however, that if search lights are placed behind [illegible] get very good practice can be made [illegible] the men are in the beam, the sights of the guns then being illuminated; if, however, the men are out of the beam, and consequently invisible, the accuracy of the practice is much reduced. On the whole, search lights promise to be a very useful adjunct on any sized vessel designed for warfare

[illegible] I desire to call attention to my recommendation of last year that the large and important navy yards be lighted by electricity. The advantages are many, and among them may be mentioned the facility furnished by the electric current for the transmission of power. But little demand would exist for electric lights in the daytime, and therefore a large current would be available for other purposes. This can, by means of small and portable motors, be made extremely valuable for working drilling and other machines, requiring but little power, that are used in ship construction and for other purposes. As a matter of fact the need of small power motors which are perfectly portable for use where steam power is inaccessible, has long been felt. Arc lamps should be used for outside lighting and in large sheds and shops, while incandescent lamps should be used in offices, houses, and generally for inside work. The scheme for the entire plant should be carefully and completely laid down before commencing, in order that the work of installation may be strictly progressive The wires should be laid underground and have ample conducting area. Posts for arc lamps should be carefully placed and spaced and arranged so as not to cast shadows from their own lamps; they should also be so arranged as to render it impossible for any person to receive a shock from the high potential current used with arc lamps. There should be duplicate dynamos and engines in a plant of this kind for simplicity in working and on account of spare parts. Provision should also be made for spares and for portable cables and lamps to be taken wherever an emergency may call for night work. The specifications for a navy yard installation should be very carefully drawn in order to exclude the wretched and dangerous materials and workman ship so frequently found in electric light plants.

Receiving Ship.—On account of the careful and strict police regulations required in these ships, where there are frequently large bodies of men and raw recruits, the latter often including men of vicious and dishonest character, the advantages and need of electric lights are great. These ships are generally supplied with boiler power, and there fore an electric lighting plant can be installed at moderate cost and economically maintained.

Demand for Electricity on Board Ship.—The tendency now is to install all ships and even torpedo boats with electric lights, and to increase the power and number of search lights. The use of incandescent lamps is found to very materially assist in rendering torpedo boats habitable. It is reported that in the English navy the dynamo rooms, located below the water line, are so warm and uncomfortable, in several instances, that dynamos for incandescent lighting are being placed on the upper decks for use when not in action. It is thought that this difficulty can be overcome in our ships by the use of fans driven by electric motors. It is not improbable that small electric motors for some other purposes may be required, but it is not likely that they will be used to any great extent on account of a want of economy, and because their use would require very large electric plants without in any way reducing the boiler capacity or other machinery of the ship. The peculiar function of electric motors is for places where the power is so small that the slight loss in economy is more than overcome by the facility afforded for transmission, where the transmission is for a long distance, and where other motors are inaccessible. * * *

Thickness of Insulations.[1]

BY [illegible].

In discussing the question of insulation in general we have heretofore confined ourselves almost exclusively to insulation resistance, but have not considered the other factors that, although not having quite the same prominence, are [illegible] importance. This evening I call your attention to the question of thickness of insulations, as [illegible] for different classes of electrical work. This paper, I regret, is incomplete, and contains only a number of [illegible] that I hope may lead to good results. It [illegible] to present data regarding different kinds of [illegible] so fully occupied that I [illegible] or make a number of [illegible] I [illegible].

[illegible] conductor has another [illegible] to prevent a leakage of [illegible] to protect the conductor [illegible] as far as possible [illegible] shown that [illegible] the first function [illegible] in the formula [illegible] striking distance in inches in [illegible] farads, and [illegible] for each kind of insulation.

[illegible]

between the arc lamps, we find according to the formula the descriptive discharge to be

$$\frac{(1400)^3 \times .035 \times 10^{-6}}{5822} = .0165 \text{ inch.}$$

About one-sixth of the thickness of the dielectric.

Thus we see that so far as electrical disruptive discharges through a dielectric concern the insulation of an electrical conductor, there is little need of considering it, especially in low tension systems, as shown by the following example: (same wire and insulation) and taking length of wire between lamps as $\frac{1}{60}$ of a mile. We have

$$\frac{(220)^3 \times .0141 \times 10^{-6}}{5822} = .0000275 \text{ inch}$$

That is, that on a circuit which carries a current of not more than 220 volts' potential, the insulation necessary to withstand any disruptive effort must only be thicker than .0000275 of an inch. But when we come to consider high tension currents (direct), the disruptive effort becomes much stronger, increasing as the formula shows, as the cube of the e. m. f. Take the example of an arc light plant of 50 lights, 2,500 volts, e. m. f.; distance between lamps $\frac{1}{20}$ of a mile:

$$\frac{(2500)^3 \times .035 \times 10^{-6}}{5822} = .094 \text{ inch;}$$

that is, the insulation is just a little thicker than the length of the disruptive spark.

Take an example of power transmission for a long distance, 10,000 volts.

Take length of wire between dynamo and ground as $\frac{1}{20}$ of a mile. We have

$$\frac{(10000)^3 \times .035 \times 10^{-6}}{5822} = 6 \text{ inch.}$$

A most surprising result, but if Mr. Acheson's formula is correct, no ordinary thickness of insulation would withstand a ground that is perfect from the surface of one wire to the outside of the insulation of the other wire.

This last illustration is an extreme case, but it is likely to be reached any day with the rapid advance in electrical work. From these examples we see that the striking distance through the dielectric is so much greater with high tension currents that it must be considered, and on 2,500 volts the insulation must at least be thicker than .094 of an inch to prevent disruptive discharges alone.

Let us now consider the alternating currents.

It can be shown mathematically that a pressure suddenly applied has twice the force that it has when gradually applied, and that the sudden reversal of a pressure causes a strain three times as great as when slowly applied; that is to say, the disruptive effort of an alternating current is at least twenty-seven (three cubed) times that of a direct current of the same potential. The alternating current produces results in the dielectric that are curious indeed. The continuous charge and discharge of the conductor sets up in the dielectric a peculiar molecular disturbance that weakens it to a certain degree. I can explain its effect in no better way than by comparing it with trans-Atlantic cables. There a similar condition of affairs exists—frequent reversals of the current—and it is a well known fact that in order to secure satisfactory working the cables need rest, in order that the molecules may assume a state of equilibrium. It is probable that the electrostatic capacity is in some way increased by these reversals.

Now, compare the number of reversals in one of these cables with the number in conductors connected to a Westinghouse machine, and judge for yourself of the effect on the dielectric in the latter case.

Let us say that the efficiency in the dielectric is decreased but one-half. Even then the disruptive effort of an alternating current is not less than fifty times greater than that of a direct current of an equal e. m. f.

Tabulating these results we have

220 volts, direct, thickness of insulation to withstand disruptive effort not less than .0000275 inch.

1400 volts, direct, thickness of insulation to withstand disruptive effort not less than .0165 inch.

2500 volts, direct, thickness of insulation to withstand disruptive effort not less than .094 inch.

10000 volts, direct, thickness of insulation to withstand disruptive effort not less than 6 inch.

1000 volts, alternating, thickness of insulation to withstand disruptive effort not less than .162 inch.

2000 volts, alternating, thickness of insulation to withstand disruptive effort not less than 1.296 inch.

In calculating the thickness to resist disruptive efforts of alternating currents, I have not considered the decrease in efficiency of the dielectric. In each and every case the calculation is made on the assumption that the ground is perfect from one wire up to the outside of the insulation of the other, and that there is no fall of potential in the length of wire considered.

The second function of the insulator to protect the conductor and itself from injury is almost of the same importance as the first, and is one that largely determines the thickness of the insulation. In connection with the thickness of the insulation comes the question of quality of insulation, not so much as a dielectric but as a protection to resist different destructive influences. These, of course, depend upon the position in which the conductor is placed.

Taking low tension currents, we find that in general the conductors are located as follows. For overhead conductors, for underground conductors, for general current distribution in buildings, and the last is subdivided into cleated work, moulded work and concealed. For high tension direct currents we find the same general locations of conductors, and in alternating current all except the last, but [illegible] in the proximity of a short circuit in the [illegible] the high tension current [illegible] conductor in the building.

[illegible] on overhead conductors [illegible] alternate heating and [illegible] temperature rain and sleet, [illegible] of conductors against buildings, [illegible] them.

All these influences affect the insulation, and if its thickness is not great enough to stand a large amount of wear from these causes, it will soon become so thin that it will be less than the striking distance, and will then be disrupted and consequent short circuits ensue. The chemical action of the atmosphere generally extends no further than the surface of the insulator, and unless that is otherwise affected will with good insulating material have no bad effects. When the insulation does not stand the effects of cold and heat, by cracking, crystallizing or splitting, the chemical compounds in the atmosphere having continually a new surface to attack, assist in the work of destruction, and the insulation soon becomes practically useless. The powerful effects of water particularly when first absorbed and then frozen, soon destroy the insulation, and make it peel and crack. Abrasion can usually be prevented by care in installation, and by further protecting the insulation by a covering of braid or tape.

With underground conductors the destructive influences are mostly chemical action and water. Any one who has had anything to do with underground work has no doubt had the experience that thickness is most necessary for long life of cables, and that a thin insulation, no matter how good it may be both as a dielectric and a protection, will soon give way from chemical action and water.

For general current distribution in buildings the insulation suffers from destructive influences that vary with each particular case, and for many kinds of work, an insulation has not yet been made that will withstand the destructive influences present, which are generally chemical. Nor is it possible to say that destructive influences will not be present, although it is possible to imagine a case in which there is little need of insulation. Gases of different kinds may be present when least suspected, and an insulation that may have stood for years without deterioration, in a seemingly parallel case will become in a short time worse than useless.

The conclusions that may be drawn are that the efficiency or life of an insulation depends first upon its quality and second upon its thickness. At the present time we cannot complain of quality. There are a number of good insulations that have stood very severe tests, not only as dielectrics, but as coverings for resisting water, and the effects of heat and cold, and, more or less satisfactorily, chemical action

I have not called your attention to the handling that insulated conductors should have during the installation of the plant. Until the wireman is educated to know that insulated wires cannot be handled in the same way as a chain cable we cannot hope to get along with thin insulation. The wonder is that there are not more grounds and short circuits in installations than there are.

What should be the thickness of the insulation? Briefly stated, the insulation should have first a thickness greater than the striking distance of the spark produced by the e. m. f. of the current to be carried by the conductors; that outside of this thickness there should be such additional thickness as will enable the insulation to withstand the destructive influences that may or can act upon it, so that the life of the insulation shall be as long as the building in which it is placed.

I can explain most clearly what I mean by these two thicknesses by referring to the specifications for insulated wire required by the Navy department:

First.—A layer of braided cotton next to the copper wire, to protect the wire, and prevent kinks from the tearing of insulation.

Second.—A layer of white rubber containing no sulphur. This is the dielectric

Third.—A layer of black rubber or okonite, for the protection of the dielectric.

Fourth.—A parceling or wrapping of tape, to protect against abrasion.

Fifth.—A covering of lead tubing to resist chemical action.

This is ideal insulation, and for the purpose required, marine work, answers all the requirements of the case.

The fault that I would find with many insulations is that on the smaller sizes of wire they are altogether too thin, while on the larger sizes there is often more than is required.

The figures proposed heretofore conform so exactly with the best practice, both American and foreign, that I think they should be adopted. They are as follows: $\frac{3}{32}$ volt thickness for low tension current; $\frac{5}{32}$ volt thickness for high tension current; $\frac{6}{32}$ volt thickness for alternating current.

This allows a fair margin of thickness for the second function of the insulation, except for very high tension, direct and alternating currents.

Good insulation means high efficiency, and goes a long way toward making electrical installations successful, and is cheaper in the long run, both to the contractor and the purchaser.

Recently Patented Improvements in Secondary Batteries.

Editor WESTERN ELECTRICIAN:

The manufacture of secondary batteries in the United States is increasing rapidly with the growing demand for this form of apparatus in electric lighting and application of power. The question as to whether or not the broad features of improvement attributed and patented to Faure is to be secured to his assignees, the Electrical Accumulator company, is now in the hands of Judge Coxe, and a decision will be rendered very shortly. The recent decision in the United States Supreme court in the Bate Refrigerator case has eliminated the only defence having any apparent merit. Faure's invention, as is well understood, was the application of an active material to a plate or support prior to immersion in the battery fluid, subsequent inventors modified the nature and form of the support plate and the manner of combining this support plate and the active material. Among batteries now obtainable, whether at the hands of authorized manufacturers or infringers, are

those having a support plate of lead, others having a support plate of lead and antimony with perhaps [illegible] mercury added, and, as regards the form of plate the key lock principle is applied to all; perforations having a smaller diameter at or near the center of the plate [illegible] with the greatest success; others have cells or perforations, the greatest diameter being at points intermediate the surfaces of the plate. Our patent record to-day shows that the specific modifications mentioned were long since contemplated and patented by an English inventor.

The result of the recent interference between the application of John S. Sellon of Hatton Garden, England, and Edmond Julien, assignor to the Julien Electric company, is shown by the issue to the Electrical Accumulator company (Sellon's assignees) of patent No. 396,958, dated January 29th, 1889; claim 2 being the issue in interference, to-wit: "In a secondary battery a plate, element or support containing lead and antimony in combination with an 'active material.'" Recent publications emanating from Julien's assignees give an impression widely at variance from what the issue of this patent shows to be the facts. The language of the technical expert of the Patent office, not referred to in the publication of the Julien company, shows what the facts really are: "If Sellon was the first to use plates formed of lead and antimony, or two or more metals, of which lead and antimony are essential, I can see no good reasons why he should not claim his invention in such broad terms as would prevent its being pirated by the addition of a small percentage of some other metal. The addition of a small proportion of zinc, tin or bismuth, all of which are well known constituents of type metals, which are essentially alloys of lead and antimony, would avoid any patent he might obtain, unless he is protected by some such claim as the one in interference, and the purpose of the claim seems to be to protect him from just this danger. Julien's claim is included in and subordinated by the claim of Sellon—for the reason that it is directed to an alloy of which lead and antimony are essential ingredients." The issue of this patent gives Sellon's assignees, the Electrical Accumulator company, the control of the battery employing an alloy plate whether the present suit, based upon the Faure patent now in the judge's hands, and upon which a decision is expected in a short time, is favorable or unfavorable. The public may therefore take warning at this time against further infringement on patented rights; for if, upon the decision being rendered against the manufacturers, such manufacturer should be insolvent or irresponsible, resort will doubtless be had to consumers or users for an accounting and for damages.

A second very important patent, granted on the same date to the assignees of Sellon for improvements in secondary batteries, No. 396,770, is also of sufficient importance to merit special attention. This is intended to cover and covers a special form of perforated plate, such as is used by the Gibson Electric company, and such as is shown in the recent modifications of Faure's invention attributed to Anthony Reckenzaun. The Gibson battery makes more or less successful use of a perforated plate, produced by piercing a sheet of lead with a series of perforations in such a manner that the openings at the surface of the plate are smaller than the diameter of the perforation at one or more points intermediate the surfaces. The claims of this patent, as will be seen from the example given, cover this construction; for instance: "In a secondary battery a plate, element or support having cells, perforations or receptacles, the diameter of which, at or near one or both poles of the major axis, is less than the diameter at one or more points intermediate said poles." This gives the assignees of Sellon a practical control of the form of battery manufactured by the Gibson company, the invention of Sellon, as shown by his English patent, having been perfected long before the construction was adopted by Gibson.

The third patent covers the construction adopted by Fitzgerald-Jones in England when they were manufacturing batteries for experimental or exhibition purposes. The Fitzgerald-Jones plan was to mould a solid peroxide plate, and attach a framework of celluloid to the edges and parts of the surface thereof; on the inside of this frame, between the frame and the peroxide plate, was a thin strip of platinum, but this construction was contemplated and perfected by Sellon long prior to the time of its adoption by Fitzgerald-Jones. This third patent, No. 396,769, was issued on the same date as the others above referred to; one claim reads: "In a battery a support or terminal containing a practically inoxidizable material combined with a conductor of platinum, and a mechanically applied active material substantially as described."

These three patents are all believed to be valid; if so their ownership places the Electrical Accumulator company in position to control the accumulator or secondary battery industry of the Faure patent.

ELECTRICAL ACCUMULATOR COMPANY,
Per T. P. CONANT.

CORRESPONDENCE.

New York Notes.

NEW YORK, Jan. 31.—The strike of the car drivers and conductors in this city is now a week old, and yesterday things began to look somewhat grave. In what direction the further developments of the situation may tend is a matter of uncertainty, but at this moment there are signs that encourage the belief that the back of the strike is broken. The proportion of horses to cars is from seven to ten, and when the waste of energy and money that is entailed by a contest such as is now going on is considered the enormous advantages of electric cars in such an emergency becomes apparent. In the near future the proprietors of street car roads will have no costly and cumbersome stables to keep up, and should a strike be organized [illegible] comparative [illegible] [illegible] city [illegible]

The Daft electric motor, Benjamin Franklin, [illegible] to run on the Ninth avenue elevated [illegible] between the hours of [illegible] with a train [illegible] Fourteenth street to [illegible]

The rooms of the New York Board of Trade and Transportation were crowded on Friday last with telephone subscribers who indorse the board's bill, now at Albany, reducing telephone charges to $6 and $3 [illegible] cities and the smaller towns of the state. Simon Sterne, who presided, briefly explained that two principal objections had been raised against legislation regulating telephone charges. The first was that the contract between the telephone companies and the subscribers was a private one, into which nobody was forced to enter; while the second set up that, as the telephone is a patented article, the state has no right to put such restrictions upon its use. But Mr. Sterne explained that he and the board held that the telephone was a public necessity; that its owners used the public highways, and that the right appertained to the state to regulate monopolies. Here the rate is $150 and $180 a year. In Vienna it is about $40; in Paris, $40 to $50; in London, $60 to $70, and in Berlin, $30; while in most of those cities the companies pay a considerable tax to the municipalities. Mr. Talcott introduced a resolution appointing a committee of twenty five to co-operate with the committee of the board in urging the passage of the bill. This resolution was passed unanimously.

The bids for lighting the streets of Brooklyn with electricity were opened yesterday in the city works commissioner's office. As there was no competition for this work, and as both the electric light companies in the city have the same president, Charles Cooper, the bids were the same as those of last year—$182.50 per year for each light. The bidders were the Citizens' Electric Illuminating company and the Municipal Electric Light company. The former supplies Brooklyn proper, while the latter is supposed to light the eastern district. The aldermen have appropriated $480,000 for street lighting purposes, and these two companies have contracts now that will take $229,220 of that sum. The aldermen order, on an average, twenty new lights every Monday.

There is great diversity of opinion among electrical men here as to the decision in the Bate Refrigerator suit, and the general impression among those who are the best capable of judging is that its force and bearing is by no means so conclusively in favor of the Edison company as might at first sight be supposed. E. H. Johnson, president of the Electric Illuminating company, is reported to have stated that: "The decision in this case established the validity of the patent involved, and carried with it the validity of ours. Mr. Westinghouse assumes no new position. He is simply the successor of other men engaged in electric affairs, who charge the Edison company with appealing to the ignorant public, while they themselves are doing precisely the same. The facts are simple. The Edison company brought suit against its infringers upon its fundamental patents. These suits were met by the defendants with the plea that the Edison patents involved had expired. This view being sustained by the courts of first resort, further progress in the litigation was then blocked. To remove this obstacle we were compelled in some way to reach the Supreme court and have the point upon which the plea was based decided. This we have done at a cost to us which is of itself sufficient to refute the charge of lack of confidence in our patents. The result of the Supreme court decision is to remove the obstructive plea of expiration of patents, thereby destroying the defense of Westinghouse and others, and leaving us in a position to force the real issue in the courts upon the question of merit. It is needless to say that we shall do this with vigor." P.

Kansas City.

KANSAS CITY, Feb. 2.—The Edison Electric Light & Power company's station will be the largest incandescent plant west of the Mississippi. It is located on Wall and Amnatte streets, and when completed will be five stories in height with basement and sub-cellar. The dimensions of the building and main rooms are as follows: Building, 54x96 feet; dynamo room located on second floor, 2[illegible]x48 feet; engine room, first floor, 20x48 feet; boiler [illegible] first floor, 20x48 feet. The seven boilers are of the Babcock & Wilcox make, and have a capacity of 2,100 horse power. The engines, fifteen in number, will be of the New York Safety Steam Power company's make, and are of 150 horse power each, with a total of 2,250 horse power. Thirty [illegible] ing. [illegible] each stack being [illegible]

The Midland Hotel company expects soon to [illegible] plant an arc machine of 25 light capacity. The incandescent plant will also be increased, as the company has decided [illegible] will be one of the largest isolated plants in the west. The wiring [illegible] Western Electric company, Chicago, under the supervision of Mr. Glover.

The Kansas City Electric Light company has received a number of Thomson-Houston direct reading alternating current meters, which will be put in position as soon as possible.

Oscar Ditsch has resigned his position as superintendent of the American Electric Light company of this city.

The association of Edison Illuminating companies will hold its ninth annual convention in this city, commencing February 12th, continuing three days. The convention will be held at the Coates House. Mayor Kumpf, in behalf of the city, will extend the visitors a hearty welcome, and will be seconded by E. H. Allen, president of the Board of Trade. Among the papers to be read during the convention are the following: "The Steam Engine," by Prof. William D. Marks of the University of the State of Pennsylvania; "New Uses for the Electric Current," by John Wirt, electrician of Bergmann & Co. of New York; "Nooks and Corners of Central Stations," illustrated by magic lantern views, by W. J. Jenks, director Edison Standardizing bureau, New York City. There will be probably one hundred and fifty companies represented.

It will be seen from the report from the telephone committee appointed by the Commercial club and its members that the rates charged subscribers by the Missouri & Kansas Telephone company are not exorbitant. The committee reported that it had been freely shown the books of the telephone company, and had been rendered all necessary assistance by the officers. A thorough examination of books and accounts showed that there are thirty-four exchanges now operated by the company with 6,388 subscribers. The gross income is $394,507, and the net profit $77,612, the royalties and patents alone costing $[illegible], and the pay-roll amounting to $11[illegible]. From this $77,612 must be deducted for the depreciation of property by storm and wear. For example, the $20,000 damage done by the sleet storm of December 2[illegible], 1888, would go into the expense account of 1889. The net earnings would amount to only 5 per cent. if improvements were taken into account. The committee reported further that the service in Kansas City was far superior to that at any other point, which superiority was largely due to superior appliances. The committee submitted as its conclusion that the service was excellent, the charges reasonable, and the earnings even less than they should be. The committee suggested [illegible] central point, as a center from which to reckon the [illegible] and Mr. Maxwane [illegible] the matter under advisement. The committee recommended to the company that the rental of residence telephones within the city limits be fixed at $[illegible]

The company [illegible] contemplates the establishment of [illegible] exchanges in outlying districts of the city, connected with trunk lines with the city exchange. [illegible] the cost to such subscribers would be [illegible] would be [illegible] an [illegible] The subscribers would [illegible] of connecting [illegible] with the central exchange [illegible] rates.

Mr. [illegible] chairman of the committee, states [illegible] that [illegible] showing the [illegible] of the company [illegible] these [illegible] its report as they were [illegible] property of the company, and had already [illegible] purpose in assisting the committee to arrive at its conclusions.

[illegible] represented in the [illegible]

[illegible] company of Cin[illegible]

[illegible] system in this city [illegible] of the Home [illegible] the present time about fifteen subscribers. D.

St. Louis, Mo.

St. Louis, Feb. 2.—The board of Public Improvements [illegible] the specifications for lighting the city by electricity. City Counselor [illegible] the plans provide that the entire city be lighted by electricity, substituting [illegible] incandescent lamps, as the location may require. The streets and public highways must be lighted every night throughout the year from forty minutes after sundown until thirty minutes before sunrise. The arc lights are to be of 2,000 candle power each, and the incandescent lamps of 35-candle power. The lights, wires and all other appliances must be kept in good condition at all times and be subjected to such improvements as may be made or discovered in electric lighting generally, so that at the time of expiration of the contracts the plant can be turned over to the city in a condition equal to that of any electric plant in the country. The wires conducting the electricity will be carried on poles, unless provision is made later to have the wires carried through conduits, on towers, or by any other improved means.

The house committee on public improvements has given another hearing to persons interested in the ordinance providing for placing electric wires in underground conduits, the basis of calculation being the Dorsett conduit. Capt. Bofinger, vice-president, and David Powell, president, of the Thomson-Houston Electric Lighting company; W. L. G. B. Allen, manager of the Brush company, and Rudolph Bohle, local manager of the Western Union Telegraph company, were speakers. The electric light men notified the committee that they were not going to patronize the National Subway company operating the Dorsett conduit, even if the latter organization secures passage of the pending bill through both branches of the municipal assembly, as they did not think the plan had as yet been sufficiently matured. They did not feel satisfied that the Dorsett composition conduit afforded sufficient protection to arc light currents, though they would be prompt to adopt the Dorsett system when its practicability has been demonstrated.

At the meeting of the house of delegates last week, Delegate Gartenbach introduced a bill authorizing the Cheltenham Railway company to construct and operate a street railway from the intersection of Chouteau avenue and the forks of the old and new Manchester roads, westward on the new Manchester road to Cheltenham, Benton, and if the company desire, to the western limits of the city of St Louis, to be operated by animal, cable or electric power. Delegate Clark introduced a bill granting permission and authority to the United Electric Light & Power company to construct and maintain and operate conduits, pipes, mains, conductors, manholes and service and supply pipes in the streets of the city, for and during the term of thirty-five years, for the purpose of distributing electric and other [illegible] approved by the board of public improvements.

Cincinnati, O.

Cincinnati, O., Feb. 2.—At last week's meeting of [illegible] J. M. [illegible], of the Cincin[illegible] presented a communication [illegible]

[illegible]

there is an immense profit in the business. I have submitted an affidavit showing that the cost to us of maintaining each subscriber annually is $60 21. I have confidence that there are a sufficient number of purè minded men in the legislature to defeat the measure." R.

Columbus, O.

Columbus, O., Feb. 2.—Mr. Rannels' bill to provide for electric executions has attracted a great deal of attention and interest in the senate, where it has been introduced. The author of the bill said in a speech in its support the other day: "I asked the members not to be influenced by prejudice as to the effects of the law. Some of the members would urge that this would make death so easy that it was defeating the end desired." It was the aim of the law to remove the criminal so he could do no further injury, but it was not desired to inflict a lingering death. Some of the members would object to the disposition of the body. He submitted that if a man's action forfeited his life, it was not going much further to say that he also forfeited his body. There was nothing so degrading as the practice of turning over the body of a criminal to the friends for burial. This law was an admonition to this class of people, that they had forfeited the right to a Christian burial. The speaker read from reports of the horrible execution of several prisoners. In each instance the rope broke. Mr. Zimmerman moved to amend by authorizing the warden to designate five representatives of the press. He maintained that the press would be represented in some way, either by the physician or some other person who had the right to be present. The amendment was adopted. Mr. Coulter had some objections to the bill. In the first place he thought there was no certainty that accidents might not occur by electricity. The senator said: "For fear the bill will pass I desire to offer an amendment to turn the body over to friends on demand." Mr. Coulter's amendment was lost. Mr. Huffman moved to strike out the section requiring the warden to take certificates from all the spectators that the death sentence had been executed. The amendment was adopted. Mr. Coulter moved to amend by extending the time before the execution from nine to fourteen weeks, instead of four to eight weeks The amendment was adopted. M.

San Francsico, Cal

San Francisco, Cal., Jan. 26.—A meeting will be held by members of the electrical fraternity for the purpose of forming an electric club similar to those in Eastern states. This is a step in the right direction, as the need of such an organization has been felt in this city.

The California Electric Light company's new central station is being rapidly pushed forward. The building is completed, and the boilers, fifteen in number, already in position. The Pacific Coast Steamship company's steamship Walla Walla is lighted by the Edison system. H.

Topeka, Kan.

Topeka, Kan., Jan. 29.—The case of Fred. Eckert against the Archer Electrical Manufacturing company of Wichita for $3,000 damages, has been on trial. Following the present case will be one against the same company for $[illegible] damages, in which Aaron Rothschilds is plaintiff. The jury in the case of the Riverside & Suburban Electrical Railway company of Wichita against J. L. Beddon and the Advance Electrical Construction company failed to agree, after being out about twenty-four hours, and were discharged. M.

St. Joseph, Mo.

St. Joseph, Mo., Jan 12.—An accident occurred at the Chicago, St. Paul & Kansas City railway crossing on North Main street last week which resulted in the death of one man and the serious injury of a number of persons. Electric car No. [illegible] of the Union Railway company north bound [illegible] of the "Diago[illegible] road and the electric car passengers [illegible] all were [illegible] feet deep into Black[illegible] creek. There were about ten passengers on board [illegible] fortunate [illegible]

[illegible] and the brilliancy of the car within, it would be almost impossible for the motor man to see the approach of the train. More than this, it was very dark that night, and the very fact that these cars on the C., St. J. & K. C. road were [illegible] down the tracks, it seems to me a flagrant piece of criminal carelessness. The train must have been coming with terrific force. The electric cars weigh [illegible] pounds each, and it is at least twenty feet from the track on which the car was at the time of the accident to the edge of the embankment. To overcome the pushing power of the electricity, the weight of the trolley wheel against the wire and these 8,000 pounds of car weight, it must have been a terrific blow, and the empty cars coming at a high rate of speed."

James Craig, jr., who has been east the past week in the interest of the Globe Electric Light company, has returned home. The power house for the electric light company will be located near the Union line power house in North St. Joseph, and very likely will be run in connection with it. While east Mr. Craig completed arrangements for putting in the Edison incande cent system, and the Edison company has taken part of the stock of the Globe company. The capital stock of the Globe company is $50,000.

Louisville, Ky.

Louisville, Ky., Feb. 2.—A number of Louisville men are building an electric street car line in Jeffersonville, a flourishing Indiana town of 15,000, across the river. The company has the exclusive franchise for street car service in Jeffersonville for fifty years. The construction of the road will be begun immediately. The proposed line will cross the new Louisville and Jefferson bridge and run in conjunction with the street car system in this city.

The construc ion of the electric line on Green street in this city is progressing rapidly, and it will shortly be ready for operation.

A 50 light incandescent plant is being installed on the ferry Hite, which plies between this city and Jeffersonville.

At the last meeting of the city council of Cynthiana, Ky., an ordinance was offered giving a franchise to the Cynthiana Electric Light & Power company. The company offered to light the city of Cynthiana by eighty incandescent lamps of not less than 16-candle power each.

The second electric light company recently organized in Paducah expects to have its plant in operation at an early day. A.

Birmingham, Ala.

Birmingham, Ala., Feb. 2.—At a meeting of the merchants of Birmingham held at the Opera House hotel recently the first steps were taken to form an electric light company. Mr. Harris, representing the Westinghouse company, offered to subscribe about one-fourth the cost of the plant. The company was named the Birmingham (Ala.) Electric Light & Power company. A committee was appointed to make applications for charter and city license, and present the legal subscription list at the next meeting.

The directors of the Edison Electric Light company held its regular monthly meeting recently. The capacity of the plant has been enlarged by about 1,500 lamps. Among other things discussed was the purchase of additional machinery for arc lights.

One of the latest industries to supply the wants of Birmingham and vicinity is the Stevens Electric company, which has just established a public lighting station, and is now running a system of the Waterhouse arc and incandescent electric lights. This makes the third electric light company here, and the proposed Merchants' company will be the fourth in Birmingham. D.

St. Joseph, Mo.

St. Joseph, Feb. 2.—The Wyatt Park Electric Railway company will operate six cars this winter. Everything that is new in street car building, or that can contribute to the convenience and comfort of the traveling public, has been secured. All of the metal work is polished brass and the seats are upholstered in Brussels carpeting. The stove is encased in a box, which is let right into the seat in the center of the car, and is a very decided improvement over those cars which have the stove in the center of the floor.

A power house of brick has been built, 50x65 feet. A building has also been erected, 50x120 feet, to be used as a car room. A number of tracks have been placed in it, and everything which will tend to facilitate building and repairing cars has been secured.

In the construction of the railway a number of steep grades were necessarily made, but the officers of the road state that on the trial trips no difficulty was experienced in pulling up these places. When the whole line is in operation, St. Joseph will have as fine an electric railway as there is in the United States. B.

THE ELECTRIC LIGHT.

It is expected that Warren, O., [illegible] tricity.

Joliet (Ill.) papers are advocating the [illegible] electric light plant.

The city council of Huntington, W. [illegible] for an electric light plant.

The Merchants Arc Light [illegible] has increased its capital stock [illegible]

The Greenville Electric Light company of Greenville, Tenn., will increase the capacity of its plant [illegible] future.

The Laredo (Tex.) Electric Light company is increasing its arc lamp plant. The company is now lighting the International depot.

Business men residing in the vicinity of Thirty-first street, Chicago, decided to form an electric light company at a meeting last week.

The Edison Electric Light & Power company of Portsmouth, Va., has been organized with H. L. Maynard president and John L. Watson secretary and treasurer.

The Columbia Electric Light, Power & Heat company at Chicago has been incorporated with a capital stock of $[illegible],000, by J. J. McEvoy, D. Barclay and M. P. Gerrity.

The Lakeside Electric Light, Power & Heat company has been incorporated at Chicago; capital stock, $10,000; incorporators, D. Barclay, E. S. Craig and Charles East.

The Johnson City Electric Light company of Johnson City., Tenn., which has been renting its power, is about to erect a new building for its plant, and will put in power machinery.

The Thomson-Houston Company will furnish 1,000 incandescent and 30 arc lamps to illuminate the inaugural ballroom at Washington. The arrangements for the decoration of the building are the most elaborate ever known in this country.

Among the recent installations of the Thomson-Houston company are the following: C. H. Talmage, Huntsville, Mo., 150 lights, incandescent; Peralta Park hotel, Berkeley, Cal., 400 incandescent lamps; Pacritina, Cal., Electric Light company, 1,200 incandescent, alternating system.

The Elkhart Electric company of Elkhart, Ind., has been incorporated. The capital stock is $30,000. The company has purchased the local arc light plant, and is enlarging its capacity, and will add an incandescent system. The company will furnish electrical power to the street railway, of which it is sole owner.

The city council of Springfield, Ill., has been considering a project of lighting the city by electricity. Mr. Ide of that city has offered to put in on a ten-years' contract a plant, and furnish 2,000 candle power arc lights at a cost to the city of forty cents per night per light.

The Western Electric company of Chicago has installed the following plants recently: Two 50 light dynamos, 100 lamps, low tension, for street lighting, and 30 lights, high tension, for commercial use, for the Tiffany, O., Gas company; 25 light plant for Pioneer Mills, Negaunee, Mich., 25 light plant at Champion, Mich., Iron mines.

It is reported that in the Place du Carrousel, Paris, a large crowd collects nightly round the electric lights. Taking hold of each other's hands a chain is formed, and the person nearest the candelabra taps the current—how is not explained—thus giving an electric shock to the whole ring. This diversion has been going on for nearly a fortnight, and the number of experimentalists is stated to be nightly increasing.

In a Pennsylvania city, this week, has been decided a question, the legal status of which, we had supposed, was beyond all cavil, says a Philadelphia exchange. An electric lighting company had put its fixtures into a building and furnished light. The tenant of the building changed from one lighting company to another, and refused to allow the first company to remove its fixtures, but used them in conjunction with the second company's system. An appeal to the law gave the former company the right to the fixtures.

The argument in the appeal in the case of Ferranti against Gaulard & Gibbs was heard in London, January 12th. It will be remembered that Mr. Ferranti's petition to revoke the Gaulard & Gibbs' patent for distributing electricity by means of secondary generators was granted by Justice Kekewich, July 9th, 1888. From this decision Gaulard & Gibbs appealed. Defendant's counsel recapitulated the heads of the three elements of his clients' patent—the dynamo sending alternating currents at high tension, the long main wire, and the secondary generator—and stated that in none of the reports of commissions before their lordships was either Gaulard & Gibbs' purpose indicated, or their special apparatus described. After some technical legal argument as to the effect of the amendment of Gaulard & Gibbs' specification by disclaimer, he went on to state that, although some prior specifications did contain some crude anticipations of Gaulard & Gibbs' patent, there was not a single instance of any user of any one of them.

Lake View, Ill., wants an electric light station or gas works, and a bill was presented to the legislature last week, which, if passed, will enable the city to build a plant. The bill provides that cities, incorporated towns, and villages shall have power to provide for a supply of gas or electricity for municipal purposes by the erection of a system of gas or electric works or by uniting with any adjacent city, incorporated town, or village in the construction of a system of gas or electric works for joint use. Cities, incorporated towns and villages may borrow money. A general tax in the same manner as other municipal taxes may be levied and collected. The expenses of erecting lamp posts, poles and wires may [illegible] shall be apportioned, [illegible] transfer, and for a temporary injunction.

THE ELECTRIC MOTOR.

[illegible] the matter in charge. The local papers strongly favor the enterprise.

In [illegible] Victoria, Australia, [illegible] time electric tramways will be extensively operated in Ballarat [illegible] tramway company.

Recent improvements in the navigation of the Thames by electric power have been so successful that a new electric boat has been constructed. Its dimensions are 65½ feet by 10 feet. Smaller launches have been operated a number of months. A floating station has been put in operation for charging the storage batteries. Other launches and stations are being designed and constructed.

Scranton, Pa., now lays claim to the title of "The Electric City." Its streets are all lighted by electricity; its street cars are run by the same force, and a good deal of its machinery is driven by the same power. Scranton is not yet twenty-three years old as a city, but it claims a population of 95,000, while some of its more sanguine citizens say the population will not fall short of 100,000.

A dispatch from Springfield, Ill., dated January 23d, says: Hoppin of Lake presented a bill in the House this morning relating to the petition granting the right of way to "any steam dummy, electric, cable, horse, or other railroad company." It provides that no company can lay down tracks in any street of the city except upon the petition of the owners of the land representing more than one-half of the frontage of the street, or so much thereof as is sought to be used by the railroad company.

The contract for the motors for the Auditorium building Chicago, has been awarded to Leonard & Izard, Chicago. The contract calls for motors of the following capacity: Four of 15 horse power, one of 7½ horse power and two of 5 horse power. No make of motor was mentioned in the bid, the firm merely guaranteeing results. The motors are to be used for operating ventilating fans. About 100 horse power in addition will be required in the hotel. The wiring for the electric light plant of the auditorium proper is completed, and that for the hotel portion of the building is well under way.

The Reliance Works at Minneapolis are making an experiment in transmitting power by electricity, having built and being about ready to start an electric power traveling crane to work in the foundry. It will have a working capacity to handle a load of twenty tons with ease. All the motions, longitudinal travel, transverse travel and raising and lowering the load, will be effected by electric motors suitably located on the crane, and which will be controlled by three small levers. The motors were furnished by the Sprague Electric Railway & Motor company, and the experiment, as far as it has gone, promises a complete success.

The Cleveland *Plaindealer*, in speaking of the electric road says: "How provokingly slow the East Cleveland cars go, or seem to go, west on Willson avenue, after a person leaves a motor car for one drawn by horses. The motor cars run along at an easy and rapid gait, and it seems like leaving a passenger train and boarding a freight train to get on a horse car from a motor car. It makes a person long for the time when motor cars will be run on all the lines, and over their entire length." It is rumored that the management of the East Cleveland road intends increasing the line before long, and extending it in several directions in Cleveland.

In the equipment of the Sprague Electric road at Atlantic City, N. J., iron poles of a very neat and tasteful design will be used throughout the entire extent of the line for supporting the trolley wire over the center of the track. These poles which will be ornamental and of a graceful appearance will be erected in the center of the street, and firmly set in concrete to prevent all bending or change of position. From either side of these poles there will be an ornamental bracket extending over the tracks for supporting the trolley wire. The silicon bronze trolley wire will be of the small size, no larger than an ordinary telephone or telegraph wire. Its high tensile strength, over eighty thousand pounds per square inch, will enable the overhead system of supports to be of the lightest and most unobtrusive character possible. This trolley wire will be reinforced by the regular system of a main conductor running parallel, and tapped at necessary intervals along the line to insure a uniform pressure of electricity at all points of the road. This main conductor is also reinforced by feeders running directly from the generating station, so that the mean weight of all the overhead work is reduced to a minimum. Each car will be equipped with two [illegible] horse power Sprague motors, flexibly suspended to insure [illegible]

[illegible] electric road were trying to induce certain property owners on Oak street to enjoin the building of the street car tracks on that thoroughfare. Such a proceeding would only delay the work a short time. The right-of-way has been granted the company over that street, and it is very certain that the road will be built. Injunction proceedings could only delay the completion of an enterprise of much importance to Chattanooga.

THE TELEPHONE.

The Lake View Telephone exchange of Chicago has been incorporated with a capital of $[illegible] [illegible] L. D. Tuttle, J. M. Cleaver, W. F. Wiemers.

The Cleveland Telephone company has removed to its new exchange, and all the offices have been consolidated into one. This will insure better service, and will be of equal benefit to the company.

The [illegible] of New York, says that at Provincetown, Mass., a government telephone expert is looking over the Cape Cod coast, making estimates relative to the establishment of telephone connections between stations of the United States life saving service. These connections are needed, and will be of much value.

An official report concerning the development of telephonic communication in Switzerland shows that, since the establishment of the first telephone in 1880, sixty-one towns have been provided with it, and there are now 6,944 telephonic stations, of which no fewer than 1,500 are in Geneva and its suburbs. Most of the Swiss towns are now connected with one another, Geneva communicating not only with Lausanne and other places on the shores of the lake, but with Berne, Zurich and St. Gall.

A dispatch from Halifax, N. S., says: At a special meeting of the Nova Scotia Telephone company, it was decided to sell the company's interests in New Brunswick to the Bell company of Canada, by which company they are to be transferred to the New Brunswick company. The Nova Scotia company also resolved to enter into a combination with the Bell company of Canada, the American Bell company of the United States, and the New Brunswick company, whereby the lines of all will connect with one another, and no opposition line will be allowed to connect.

A dispatch from Lansing, Mich., dated Jan. 30th, says the senate has ordered the auditor general to furnish statistics of the annual tax paid by telephone companies and the annual valuation of the companies since 1881 to enable it to act intelligently on a bill presented by Senator Wisner. By its provisions the rental charge of telephones shall not exceed $3 a month for one instrument and $2 [illegible] a month each where two or more are used in the same establishment, or by the same lessee. The proposed charge for distance telephoning is fixed at fifteen cents for the first five minutes, and five cents for each five minutes thereafter.

THE TELEGRAPH.

A London dispatch says: The Anglo-American Telegraph company has issued a report stating that since the establishment of the [illegible] [illegible]

It is stated that the English admiralty has adopted the [illegible] telegraph and electric signaling system known as Willis' patent, which will replace the mechanical system now in use. The Willis arrangement was subjected to the [illegible] [illegible] All new ships and vessels re[illegible] will be supplied with these instruments. In appearance and in handling the new electric telegraph is much the same as the old mechanical system. Its greatest advantage is that signals can be acknowledged as under [illegible]

Miscellaneous Notes.

[illegible] of the Woodward [illegible] the patent rights in [illegible] a company [illegible] The Came [illegible] large amount of money in pushing the storage battery.

[illegible] Engineering [illegible] construction company of Chicago has been incorporated with a capital stock of [illegible] for the manufacture, installation, operation and disposition of machinery [illegible] The incorporators are M. L. W[illegible], W. [illegible] and [illegible].

The London *Electrician* says: If the electric dissipation of fog should prove to be practicable under open air conditions we shall have to consider how far its realization is a commercial possibility. A compound transformer, or battery of transformers to give fifty or a hundred thousand volts, fixed on the tops of the lamp posts, and supplied with an alternating current from the regular service main, comes as near as anything we can at present see toward the realization of Dr Lodge's idea, although it must be admitted that high potential transformers are likely to be somewhat expensive luxuries. The fog on Dec. 31, however, cost the metropolis nearly £10,000 for gas alone—to say nothing of railway and street accidents, loss of time, loss of health, and general miseries—so that there really ought to be no difficulty in finding the money required for an experiment which is, to say the least, not unpromising In the case of fog, prevention is most emphatically better than cure and if we can get rid of fog at the expense of a shower of rain, and at the same time reduce our gas bills, no effort should be spared to attain a consummation devoutly to be wished.

Personal Paragraphs.

[illegible] of the Woodward Electrical company of Detroit was in Chicago last week.

E. W. Carritt has resigned the position of secretary and treasurer of the Empire City Electric company of New York to assume the management of the electrical department of the Mutual District Messenger company of New York.

Business Mention.

The Philadelphia office of the Fort Wayne Jenney Electric Light company has been removed to 907 Filbert street.

Jas. W. Queen & Co., scientific instrument makers, Philadelphia, have removed temporarily across the street, while their old quarters are undergoing repairs.

Leonard & Izard, electrical engineers of Chicago, closed six electric light contracts last week. The firm is now independent of any system, and is prepared to introduce all systems.

The Phœnix Glass company of 729 Broadway, New York, has just issued a handsome catalogue devoted to the illustration of globes manufactured by the company. Several hundred cuts are presented, showing different styles of globes made by the company.

H. T. Paiste of Philadelphia is building up a good business in electrical specialties. At present this firm is having a particularly heavy run on switches, their capacity being taxed to keep up with the orders. Another of its specialties is an important insulating cut-out joint which is a fixture of most convenient character.

Henry G Cardley and Jas. E. Hayes announce their partnership in the general commission business at 37 Barclay street, New York, with a branch office at 46 Federal street, Boston, Mass., succeeding to the business of the Union Indurated Fiber company at those points. Mr. Cardley was from the formation of the latter company its [illegible]

[illegible] testing of [illegible] Harvard University the following statement appears: "This laboratory offers unusual [illegible] electrical instruments as [illegible] Having been [illegible] [illegible]

of John Stephenson became almost as frequent an entry on the official records of the United States Patent Office at Washington as that of Thomas A. Edison is to-day. In 1872 the business of Mr. Stephenson was incorporated on a joint stock basis, under the style of the John Stephenson company (limited). The officers of the company now are: John Stephenson, president; Hy. C. Valentine, treasurer, and L. M. Delamater, secretary. The company is now the largest street car builder in the world, and there is scarcely on the face of the globe a city or town inhabited by civilized human beings in which the vehicles built by the company are not to be found. Over 400 hands are employed, and the great works on East Twenty-seventh street are being taxed to their utmost extent.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, furnishes the following quotations on some of his specialties in telephone stocks:

Chicago	300	305
Central Union	48	49
Michigan	79	80
Great Southern	30	35
Colorado	40	41
Rocky Mountain Bell	39	40
Cumberland	65	68
Wisconsin	115	117
Bell of Missouri	140	152
Iowa Union	23	25
Missouri and Kansas	69	70

Electrical Patents.

Issued January 29, 1889.

396,723. Electrically-operated Door Lock. Charles B. Beers, Bridgeport, Conn.

396,725. Device for Controlling Electric Motors. Harry H. Blades, Detroit, Mich.

The invention comprises a switch operated by hand for regulating the amount of current and through the current the speed of the motor, and another switch operated by the foot for starting, reversing and stopping the motor.

396,734 Octuplex Telegraph. Mark W. Dewey, Syracuse, N. Y.

The invention consists in several sections of battery with three single current transmitters or keys and one double current or pole, changing transmitter so combined that when a certain key or certain keys are operated they will send currents to line that will select and operate the corresponding receiving instrument or instruments, and no other.

396,748. Electrical Railway Signal. William P Kookogey, Brooklyn, N. Y.

396,749. Railway Signal. William P. Kookogey, Brooklyn, N. Y.

The first claim reads "In combination with a local electric circuit containing a light-giving device and located at the station or point to be lighted, a second circuit adapted to be closed by a train passing along the track at a point in advance of the station or light, an electro magnet included in said second circuit, and a circuit-closer included in the light circuit, and adapted to be attracted by the electro magnet and to complete the light circuit whenever the second circuit is completed through the bridging of the rails by the train."

396,750 Railway Signal. William P. Kookogey, Brooklyn, N. Y.

The passage of the train over certain insulated sections of the tracks is caused to complete local light circuits and display the lights or signals at the desired points.

396,769 Secondary Battery. John S. Sellon, Hatton Garden, County of Middlesex, England Patented in England, Dec. 23, 1881.

The object sought is a support that is inoxidizable while possessing extreme lightness.

The first and last claims follow: "1. In a secondary battery, a plate or support containing inoxidizable material supporting a sheet, plate or conductor of practically inoxidizable metal, and combined with an active material or material to be rendered active mechanically applied thereto.

"8. In a battery a plate or support containing a practically inoxidizable material and a practically inoxidizable metal having a woven shape, combined with a mechanically applied active material."

[illegible] Secondary Battery. John S. Sellon, Hatton Garden, County of Middlesex, England. Patented in England [illegible]

The invention relates to the supports or frames in or upon which the active material is placed or tacked. [illegible] claim is given: "[illegible] In a secondary battery, a plate element or support having a series of [illegible] perforations, the aperture or diameter of which [illegible] surface [illegible] than the aperture or diameter [illegible] the surfaces of said plate, [illegible] placed in such hole or perforation."

[illegible] Automatic [illegible] for Electric Motors. George H. [illegible], Baltimore, Md.

[illegible] of the invention is primarily to control [illegible] the supply shall be [illegible] shall be prevented [illegible] charge.

[illegible] John J. W[illegible]

[illegible] John Young [illegible]

The objects of the invention are to enable the clerk of a hotel to answer back when a guest calls, to summon a guest at any time and in case of fire or other danger to ring the bell successively in the different rooms.

396,836. Electric Lighting and Heating Cars. Jabez F. Shawhan, Dayton, O.

Claim 8 reads: "The combination, with a car provided with the ordinary fluid-pressure brake apparatus, of a reservoir connected with said brake apparatus, a motor connected with the valve, and a generator driven by said motor, whereby the motor is operated directly from the brake apparatus when the pressure is greater therein than in the reservoir and from the reservoir when the pressure therein is greater than in the brake apparatus."

396,847. Wire Hook. Peter Ashen, New York City, N. Y.

The invention is defined in the first claim as follows: "An insulated hook for supporting electric wires, consisting of two arms arranged parallel to a main stem by means of a cross-bar on each side of which they project."

396,867. Dynamo-Electric Machine. Perrin Grant, Baltimore, Md.

The construction of the machine is such that on a change in the current passing through the same a current from one or more shunt coils will be automatically thrown into circuit or out of circuit accordingly as the strength of the current of the dynamo or motor is increased or decreased

396,870 Electric Battery. Charles F Heinrichs, New York, N. Y.

396,871. Electric Battery. Charles F. Heinrichs, New York, N. Y.

396,880. Electric Switch or Cut-out. Edward R. Knowles, Brooklyn, N. Y.

396,897. Suspending Electric Light Lamps. August Siegrist, Buffalo, N. Y

396,920. Electric Cut out Device. J. Chester Chamberlain, New York, N. Y.

396,932. Regulator for Dynamo Electric Machines. Arthur J. Holt, Grand Rapids, Mich.

The claim is as follows: In a compound dynamo-electric machine, the combination, with the commutator, of commutator brushes connected to the field coils included in series with the armature and external circuit, and independently adjustable commutator brushes connected with the field coils in derived circuit, and located on the commutator at points intermediate between the points of maximum and minimum potential of the armature.

396,940. Automatic Electric Cut-out. Edward R. Knowles, Brooklyn, N. Y.

396,941. Armature Winding for Dynamo-Electric Machines. Edward R. Knowles, Brooklyn, N. Y.

The claims follow: "1. An armature having its coils divided into a number of groups, each group consisting of a number of separate bobbins or wires, and one-half of the bobbins in each group wound parallel to each other and parallel to and on one side of a given diameter, alternate bobbins in the several groups starting from opposite sides of the same end of the armature.

"2. An armature having its coils disposed around it in groups of parallel wires starting in alternation from opposite sides of the same end of the armature and similarly ending at the same end of the armature, the ends of the said coils or bobbins of the several groups being connected in alternation."

396,942. Commutator for Dynamo Electric Machine. Edward R Knowles, Brooklyn, N. Y.

The invention is designed to prevent uneven wear by the brushes

396,951. Revolving Photometer Stand. James W. Packard, New York, N. Y.

396,958. Secondary Battery. John S. Sellon, Hatton Garden, County of Middlesex, England. Patented in England Sept 15, 1881.

The claims read: "1. In a secondary battery the combination of a positive element containing lead and antimony combined with an oxide of lead, and a negative element containing lead and antimony combined with an oxide of lead.

"2. In a secondary battery, a plate, element, or support containing lead and antimony, in combination with an active material

"3 In a secondary battery, a perforated plate, element, or support composed of lead and antimony, to, in, or upon which, is applied an active material."

396,983. Railway Telegraph. Baylus Cade, Louisburg, N. C.

397,006. Regulator for Dynamo Electric Machines. Jesse F. Kester, Terre Haute, Ind.

Claim 1 is as follows: "1. In a regulator for an electric motor or generator, the combination, with the armature and commutator segment, of a normally open short circuit connecting two or more such segments, and a speed governor attached to a rotating part of the machine for closing said short circuit, whereby the armature coils corresponding to said segments may be thrown from the line into said short circuit when the machine reaches a definite speed."

397,007 Dynamo Electric Machine. Jesse F. Kester, Terre Haute, Ind.

The invention consists essentially of a magnetic field [illegible] for throwing the line of force into the armature [illegible]

[illegible] Railway Telegraphy Baylus Cade, Louisburg, N. C.

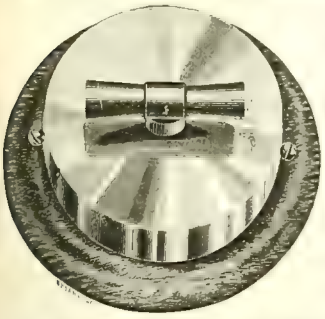
Treasury Department,

OFFICE OF THE SECRETARY,

WASHINGTON, D. C., February 1, 1889.

Sealed proposals will be received at this Department until 2 o'clock [illegible] M., Monday, February 25th, 1889, for illuminating the new U. S. Court House and Postoffice, Baltimore, Md. [illegible] Drawings and Specifications will be furnished upon application to the Assistant Superintendent of the Treasury. A deposit of twenty-five dollars will be required as a guarantee for the return of the drawings and specifications.

C. S. FAIRCHILD, Secretary.



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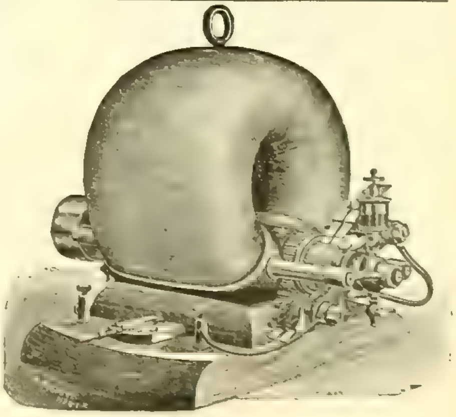

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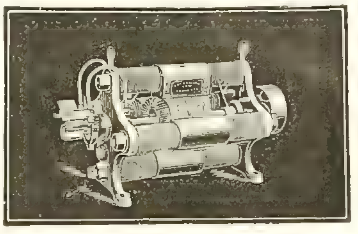

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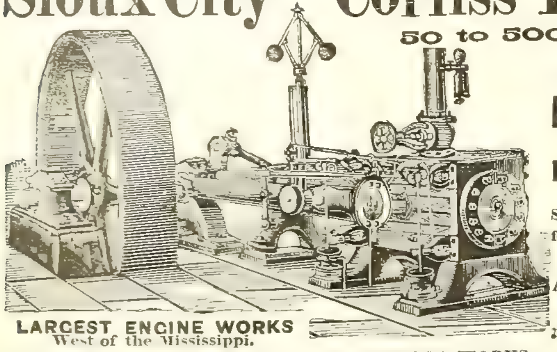

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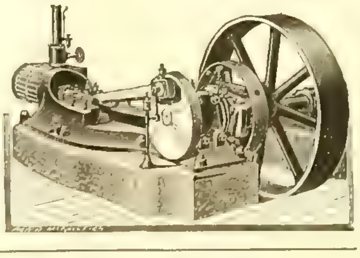

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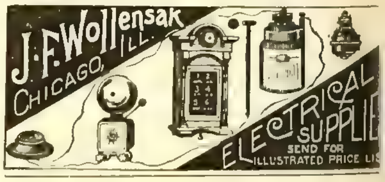

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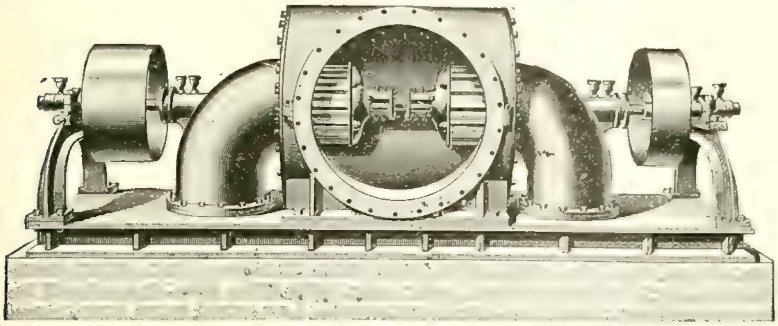

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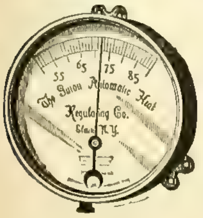

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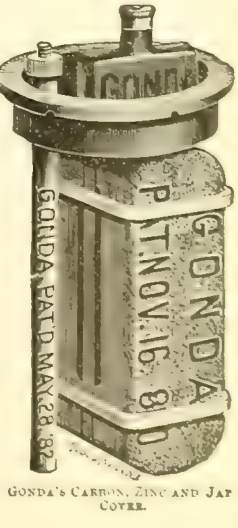

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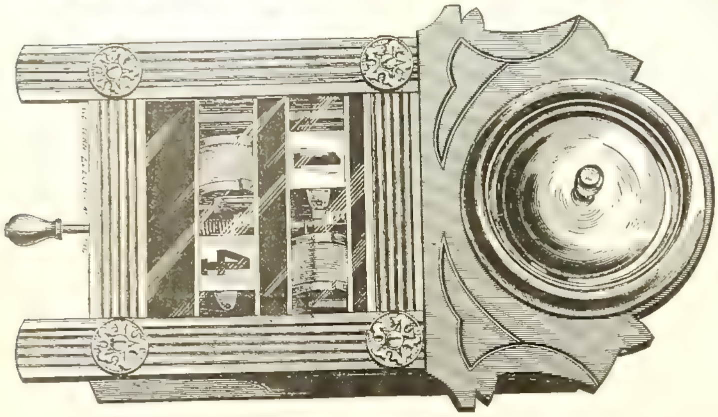

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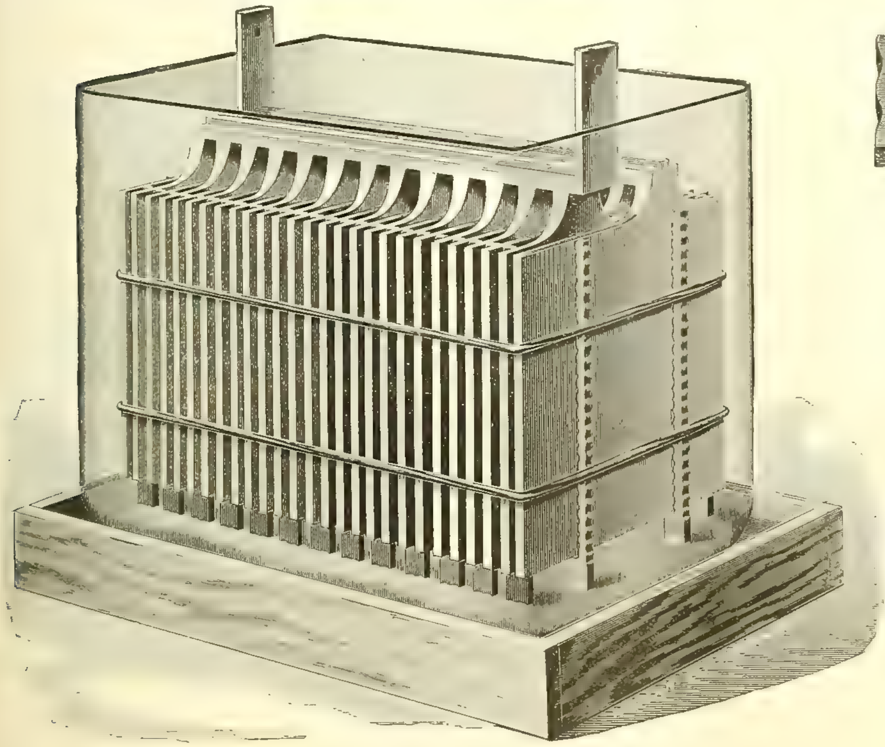

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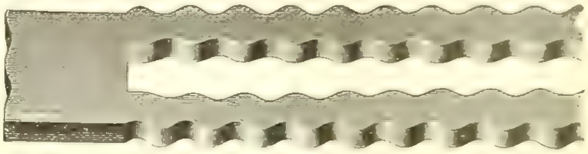

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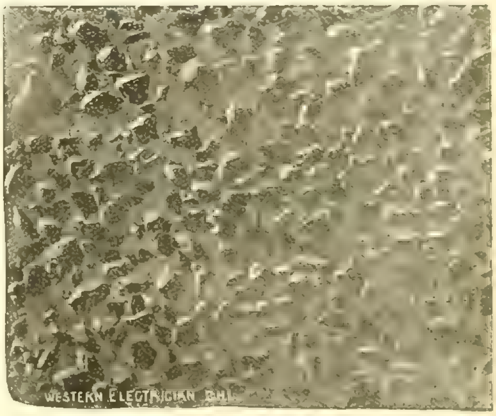

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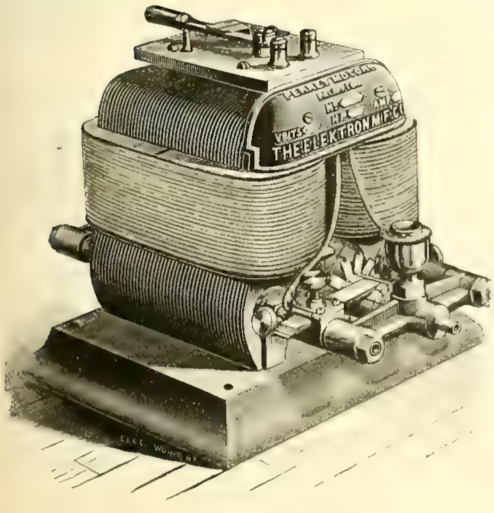

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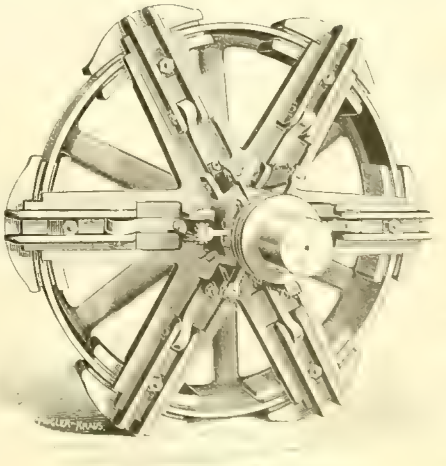

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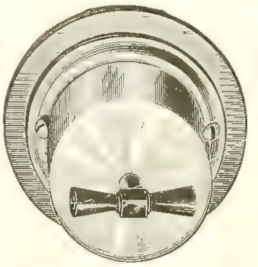

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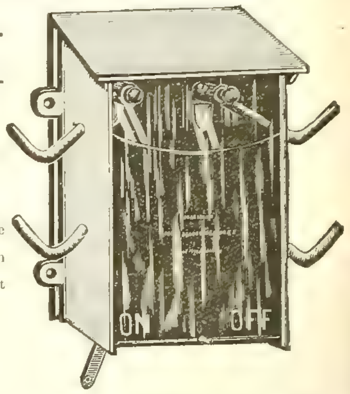

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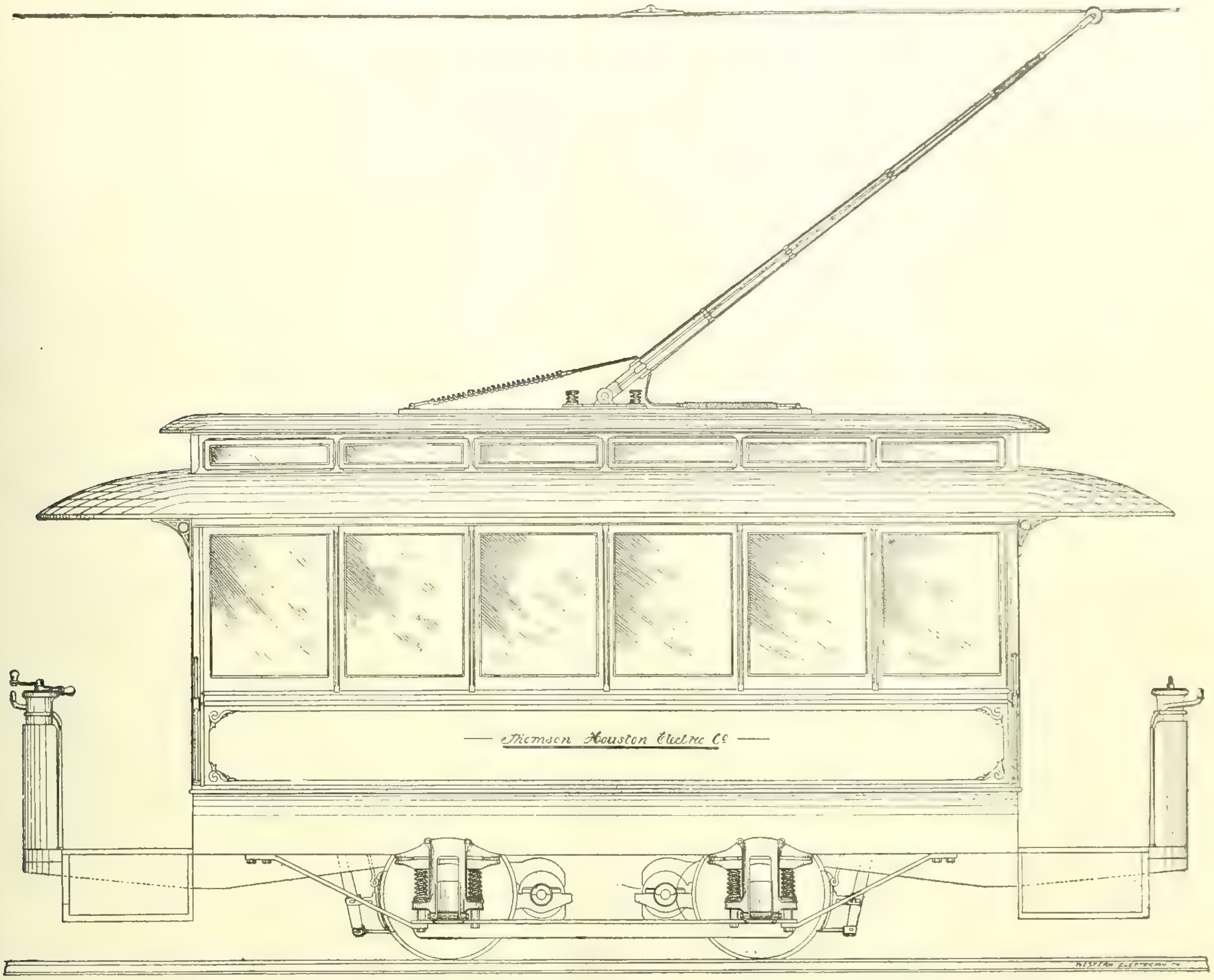

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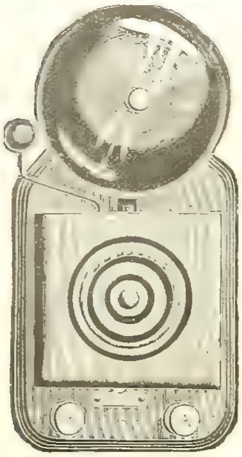

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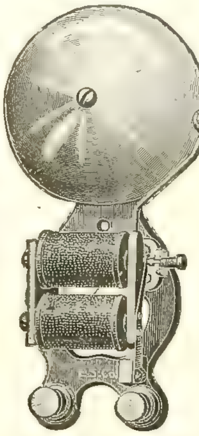

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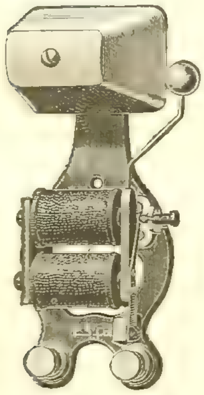

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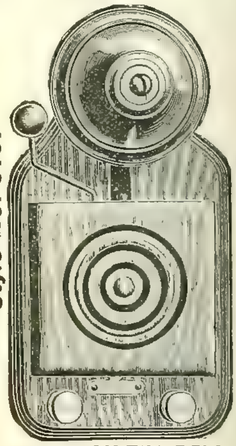

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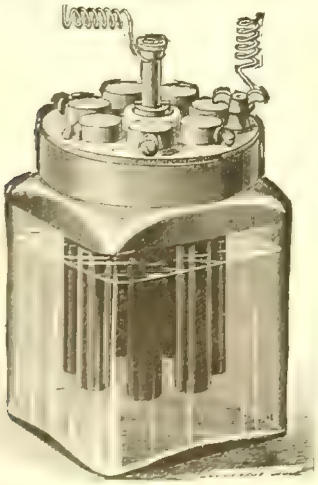

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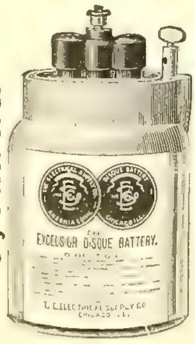

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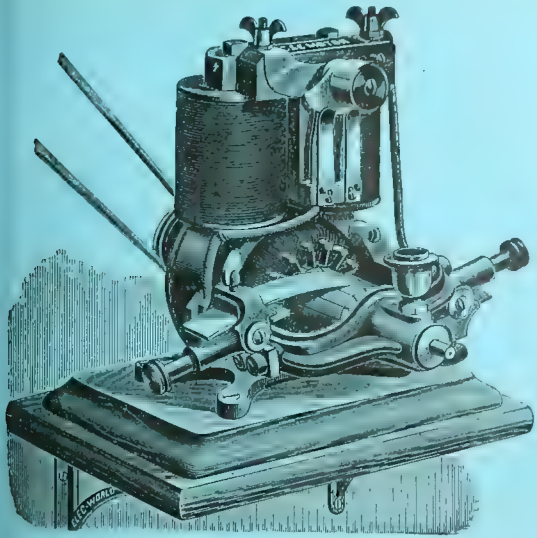

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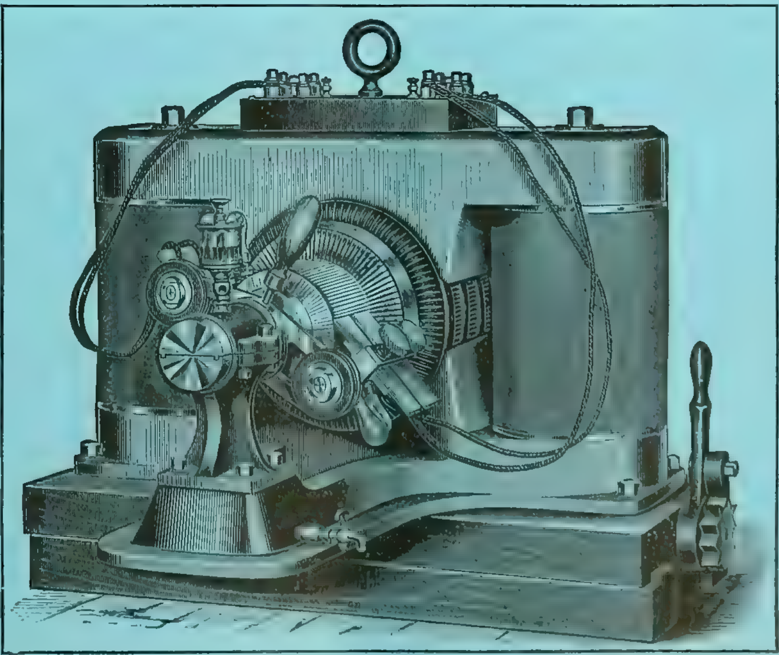

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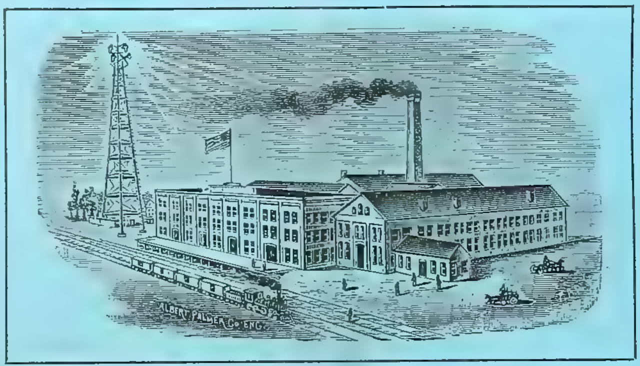

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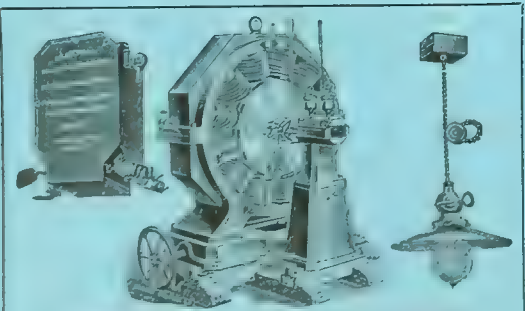

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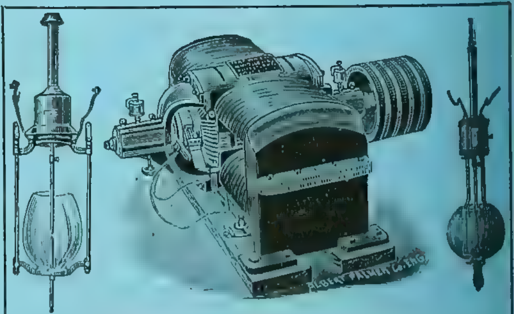

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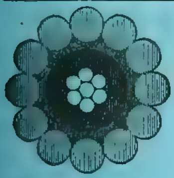

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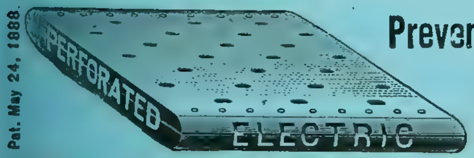

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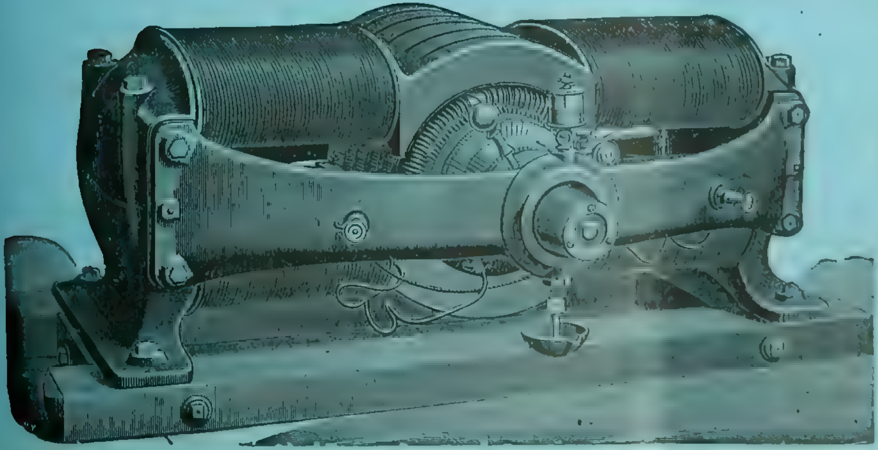

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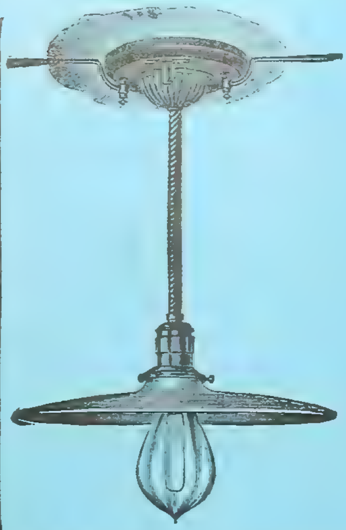

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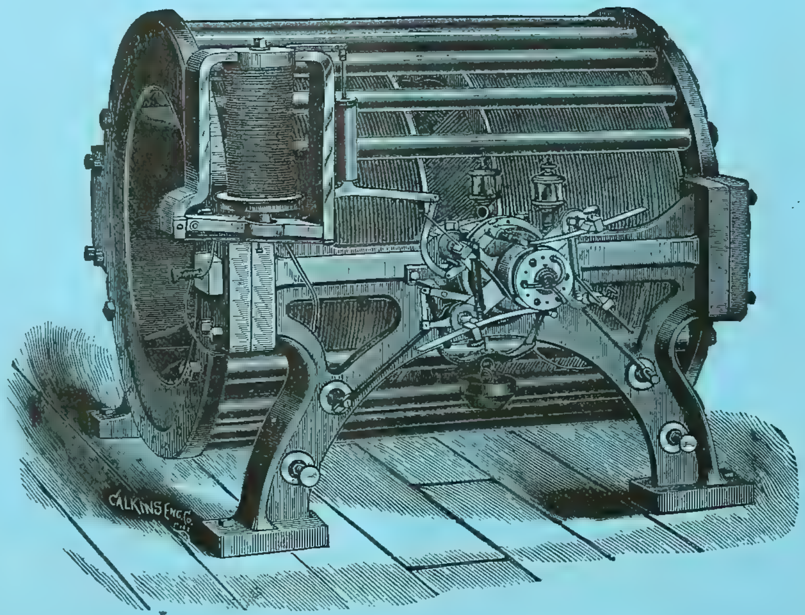

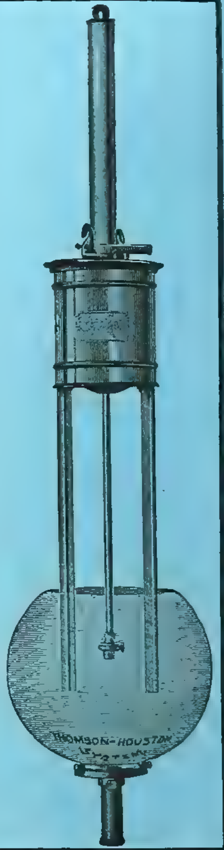

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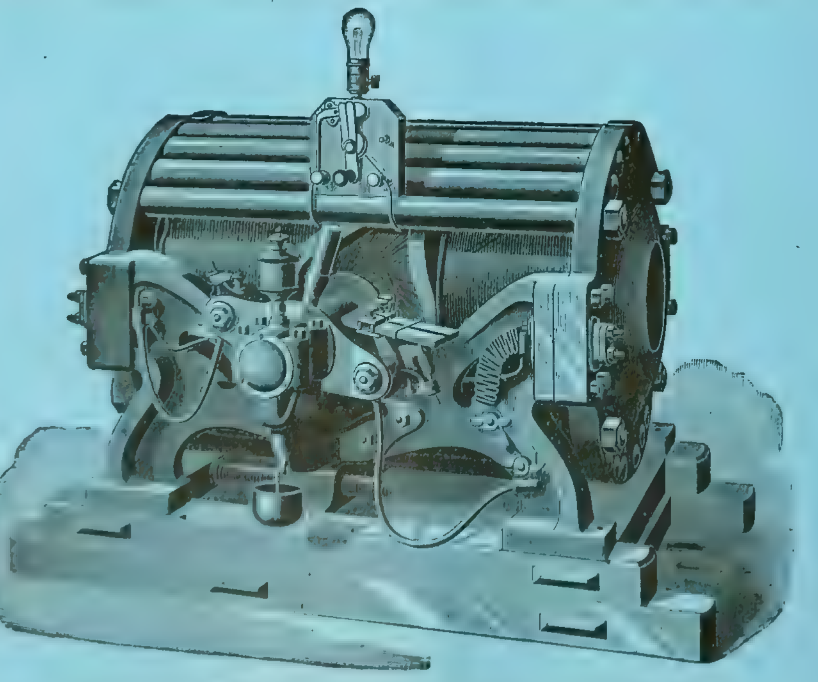

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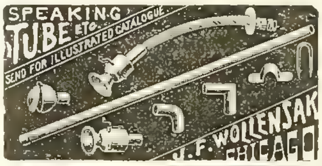

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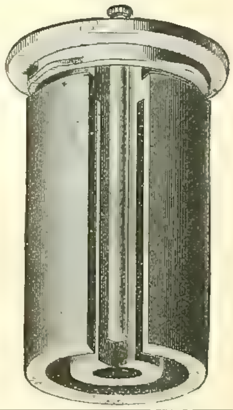

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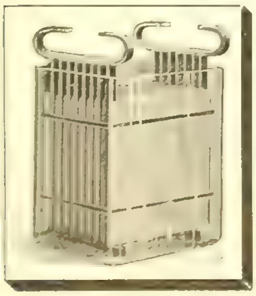

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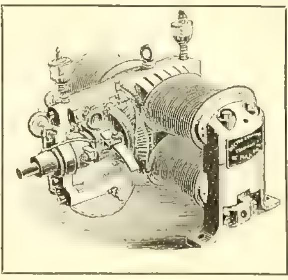
Dynamos,  Motors,

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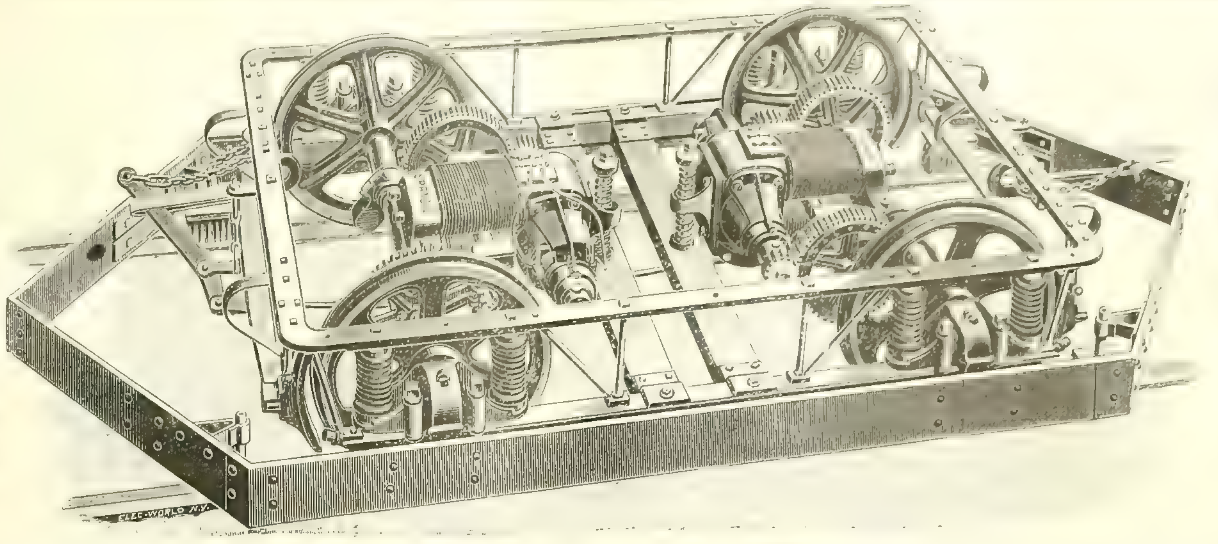

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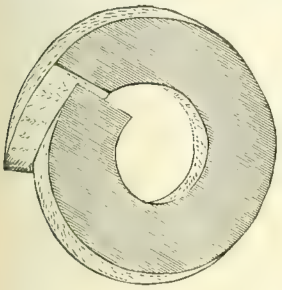

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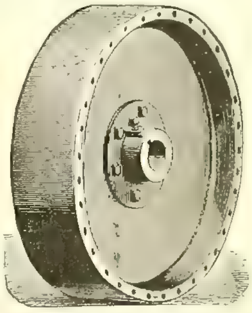

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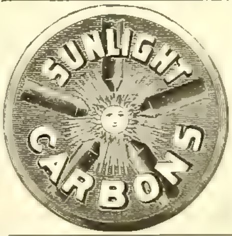

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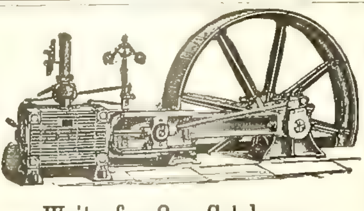

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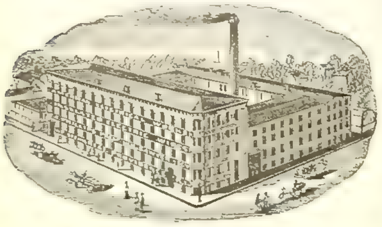

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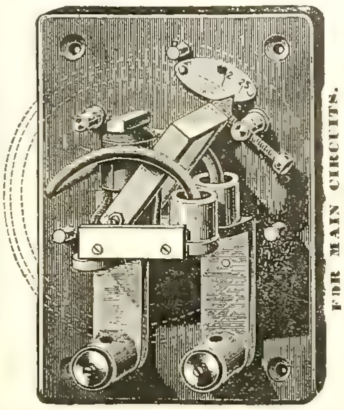

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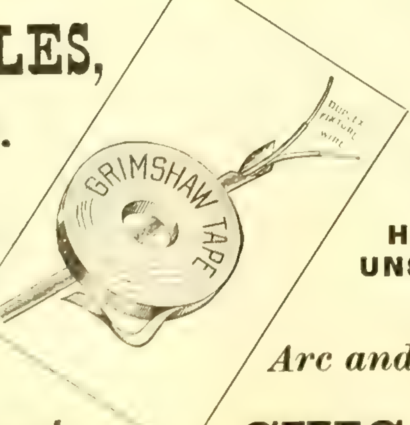

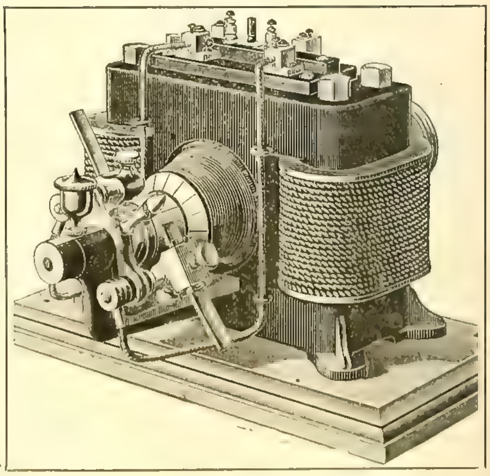

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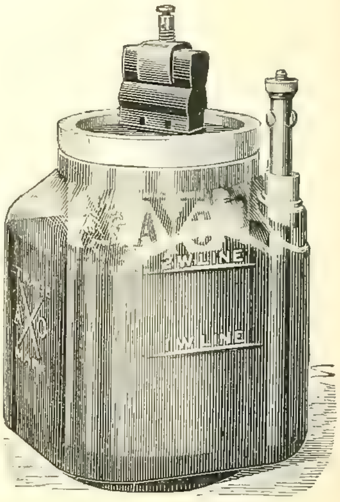

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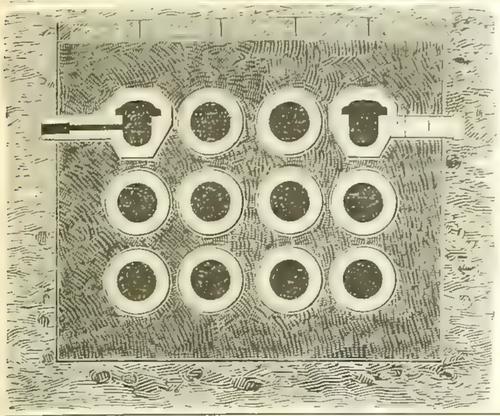

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Electrical Apparatus and Supplies,

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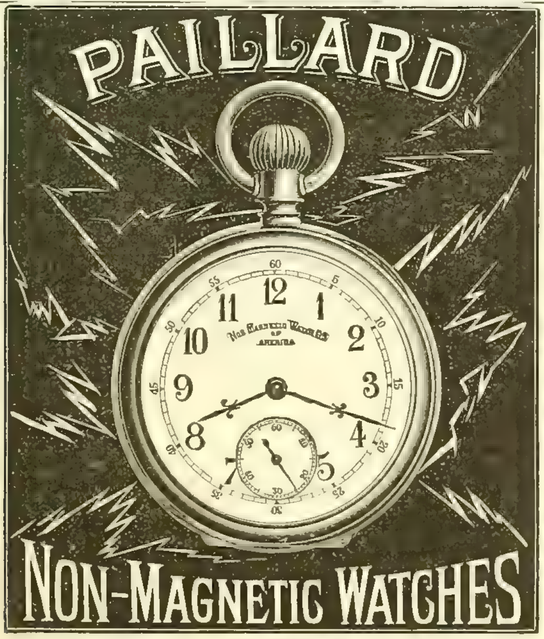

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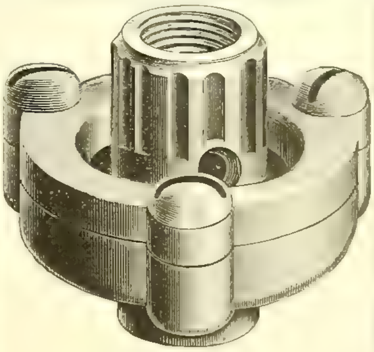
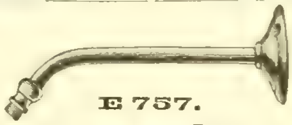


E 463.
INSULATING JOINT.
(THE STANDARD.)



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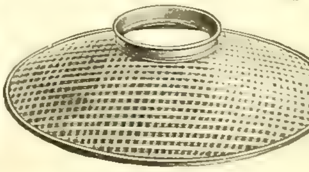
E 754.



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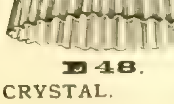
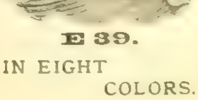


E 48.
CRYSTAL.

ETCHED.
E 36.



E 39.
IN EIGHT COLORS.

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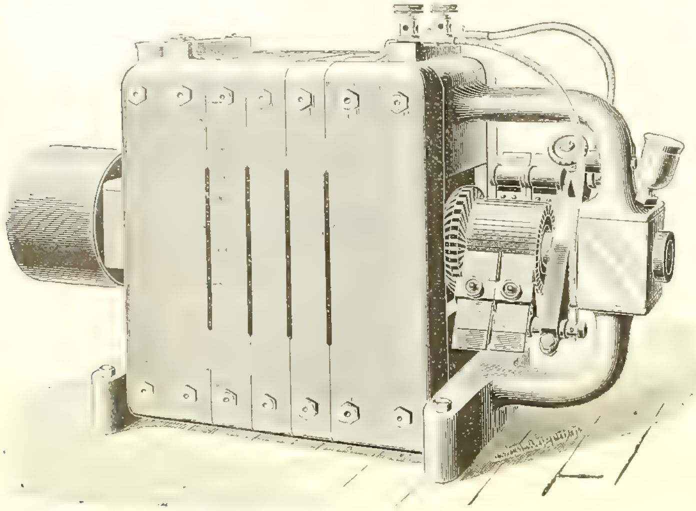
—AND—

ELECTRIC MOTORS.

(United States Patents, Feb. 22, 1887; Feb. 14, 1888.)



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NO RADIATION OF FIELD MAGNETISM.

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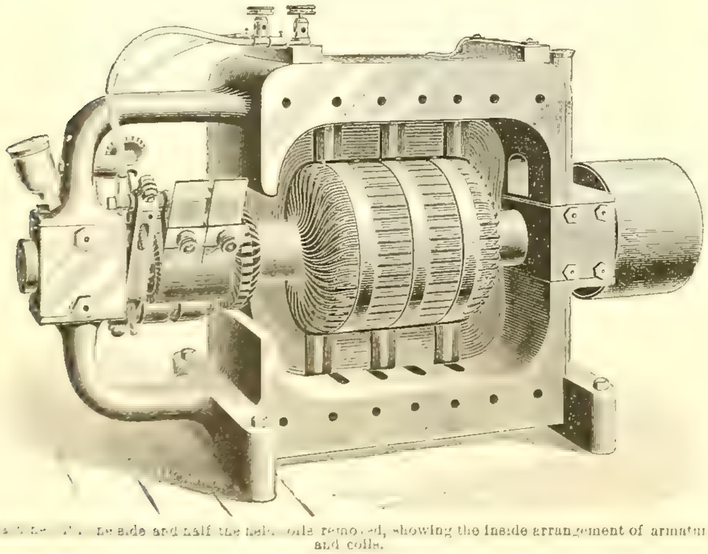

[illegible] side and half the [illegible] coils removed, showing the inside arrangement of armature and coils.

These machines, in all sizes, and of any required capacity, are for general sale on their merits **to the Trade,** to **Contracting Engineers,** to **Electric Light, Power, and Storage Battery Companies,** and to the public, without restrictions or royalties as to territory or patents.

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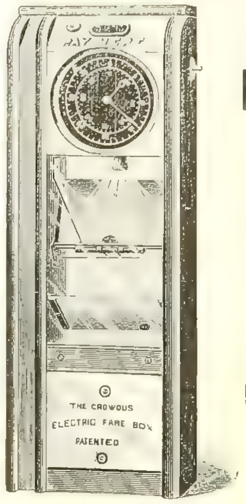

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Labor Saving Device.

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IF NOT ALL WE CLAIM FOR THEM,

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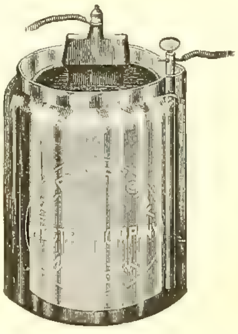
The Empire City Electric Co.



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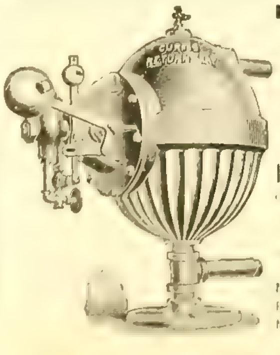
WESTERN AGENTS THE OKONITE CO., and the Return Call System of Hotel Annunciators. Fire Alarms for Cities and Towns We own the Franchises of the Western States and Territories for the

IMPROVED McCULLOH

AMERICAN + DISTRICT + TELEGRAPH + SYSTEM,

and are prepared to give franchises and construct plants on reasonable terms.

☞ Estimates furnished and contracts made for any and all kinds of Electrical Work in any part of the West. Correspondence solicited. Illustrated Catalogue and Price List on Application.
Authorized Contractors: Edison Electric Light and Gamewell Fire Alarm Telegraph.



THE CURTIS

PATENT RETURN STEAM TRAP.

[illegible] positive, rapid, [illegible] condensation back into the [illegible], and work [illegible] with reduced pressure of exhaust steam, also when the return [illegible] below the water line of the boiler.

THE CURTIS REGULATOR COMPANY,

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GENERAL AGENCIES.

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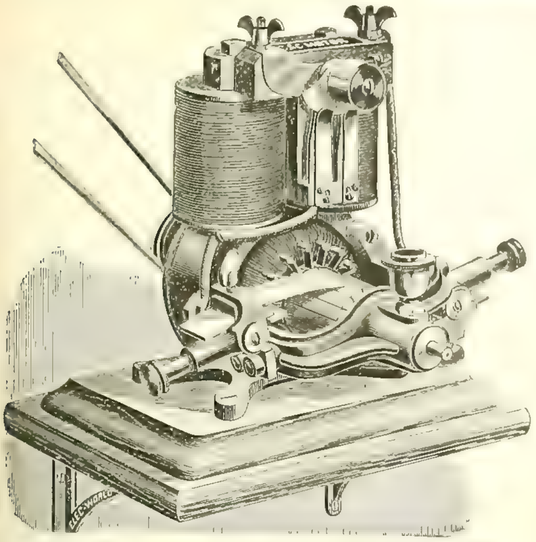
PHILADELPHIA, [illegible] st. ST. LOUIS, 707 Market st.
MINNEAPOLIS, [illegible] NEW ORLEANS, 21 Union st.



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ABSOLUTELY
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LAMPS

Never Blacken, and a Long Life is

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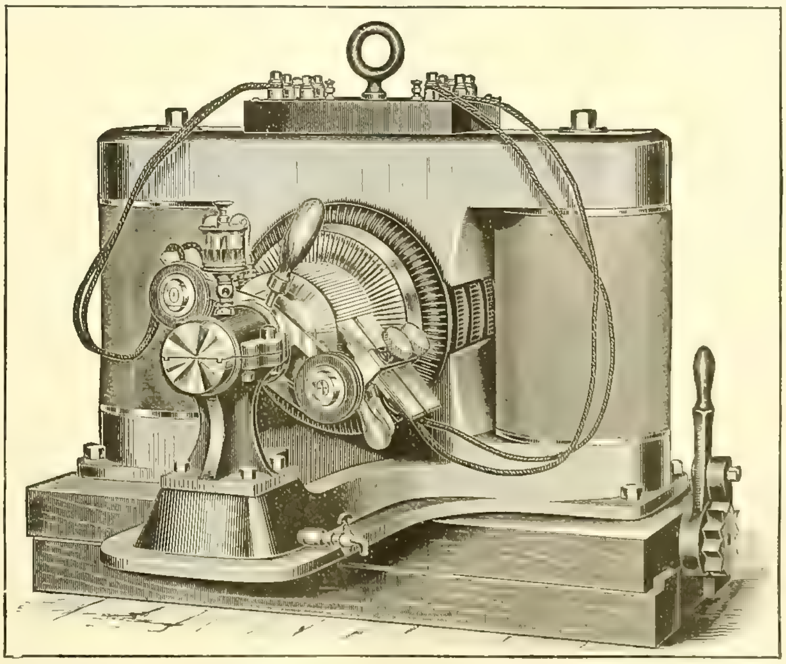

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SYSTEM.

HIGH OR LOW TENSION, DOUBLE OR SINGLE CARBON LAMPS.

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DYNAMOS OR LAMPS

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WITH SMOOTH METALLIC RUBBER SURFACE.

This Belting is of Superior Quality, and specially designed for use on

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This Company has manufactured the Largest Belts made in the world for the principal Elevators at Chicago, Buffalo, Jersey City and New York.

STEAM AND WATER HOSE,

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Rubber "Test" Hose, made of Vulcanized Para Rubber and Carbonized Duck.

Cotton "Cable" Hose, Circular, Woven, Seamless, Antiseptic, for the use of Steam and Hand Fire Engines, Force Pumps, Mills, Factories, Steamers and Brewers.

PATENT ELASTIC RUBBER BACK SQUARE PACKING.

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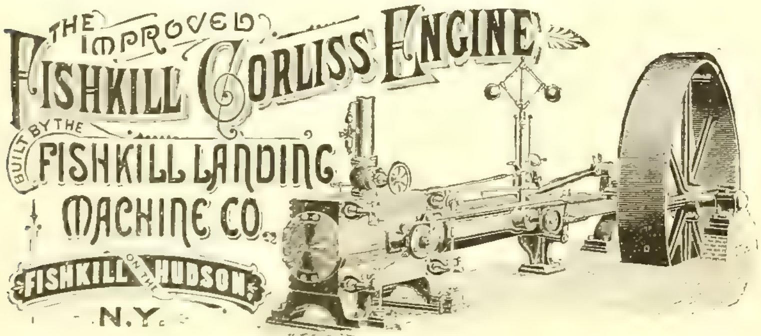

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An Examination will satisfy anyone of this.

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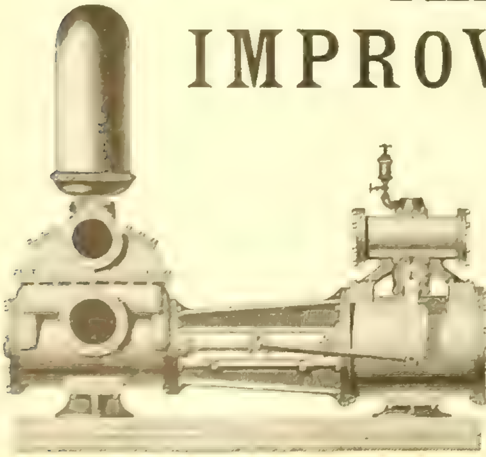
IMPROVED STEAM PUMPS,



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To Prove it, WE CHALLENGE ALL MAKERS of Steam Pumps

TO A PUBLIC COMPETITIVE TEST.

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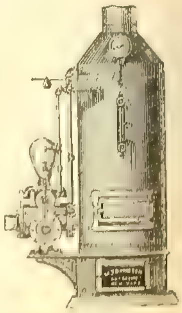
Works: Brooklyn, N. Y. Principal Office: 77 Liberty St., New York.



PUMP AND BOILER COMBINED.

THE

Westinghouse Electric Co.,

PITTSBURGH, PA.

[**Manufacturers under Patents and Applications for Patents controlling the sale and use of Alternating Current Electric Lighting Apparatus and Distributing Systems.**]

The success of the Alternating Current System of Electric Lighting is demonstrated beyond question.

Note the sale of 143 Central Station Plants by this Company, aggregating a total generating capacity of 250,000 16-candle-power lamps, within the brief period of twenty-five months, together with the fact that out of these 143 Central Stations, 38 have increased their plant since starting.

IMPROVED LAMPS.

By reason of an improvement in the manufacture of Lamps which has been secured for the exclusive benefit of the users of apparatus furnished by the Westinghouse Electric Company, this Company will guarantee from its Apparatus and Lamps 50 per cent. more light from a given expenditure of power (fuel) than can be obtained with any direct current system.

ALTERNATING CURRENT METERS.

This Company's Meter measures the whole current by a positive mechanical movement.

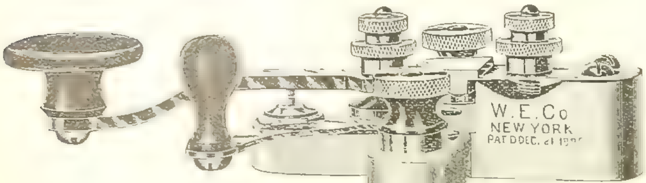
It registers directly in lamp-hours, and indicates by dials like a gas meter. It is not affected by temperature or local conditions.

ALTERNATING CURRENT MOTORS.

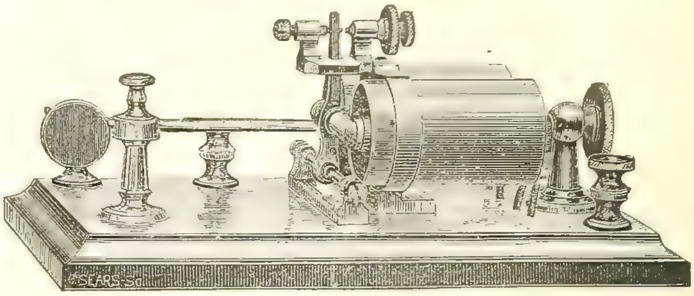
Highly efficient. Have no commutators or brushes, and can be started, regulated and reversed without breaking a connection.

Small Motors for use on existing Alternating Circuits of this Company.

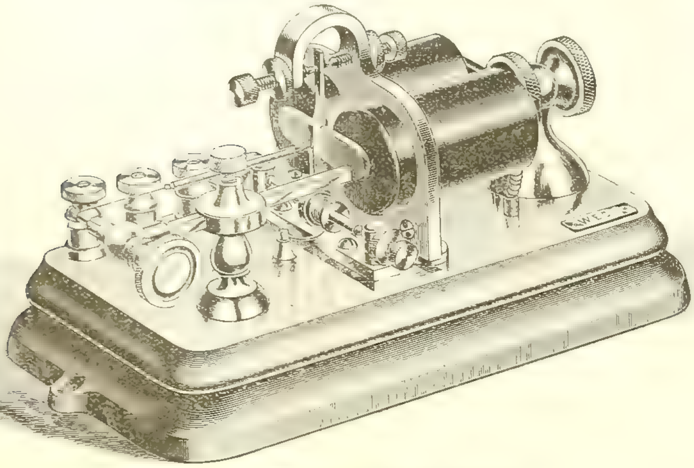
MORSE INSTRUMENTS.



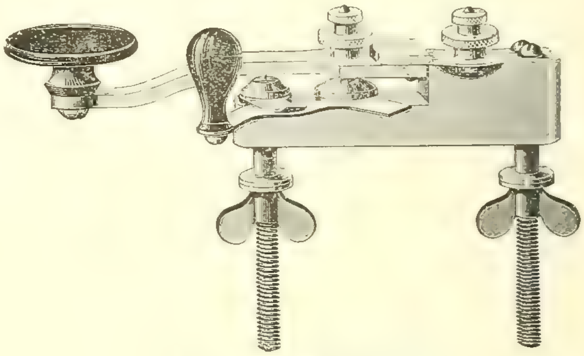
STEINER LEGLESS KEY.



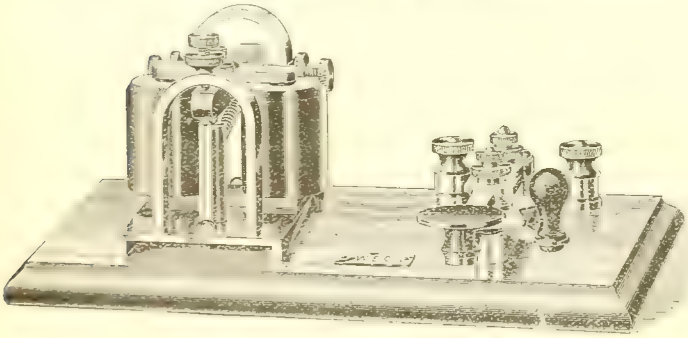
NO. 1 RELAY, CATON PATTERN.



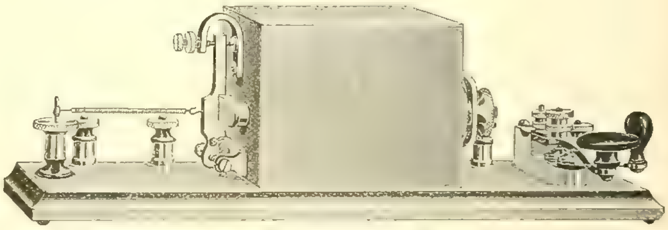
NO. 2. WESTERN UNION RELAY.



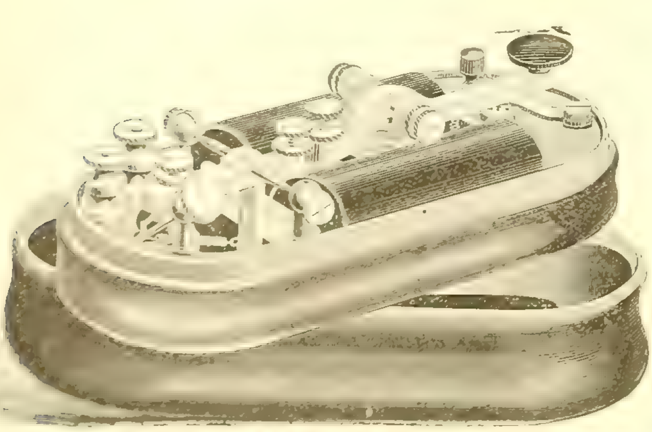
STEINER KEY WITH LEGS.



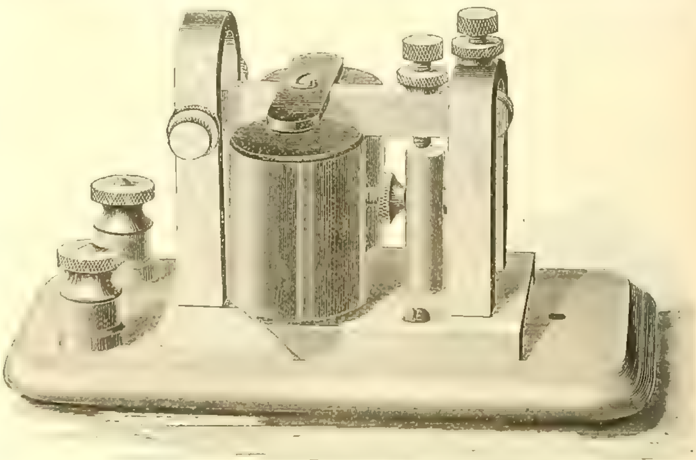
PRIVATE LINE INSTRUMENT.



BOX RELAY, WITH KEY.



POCKET RELAY



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PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. IV. CHICAGO, FEBRUARY 16, 1889. No. 7

B. E. Sunny.

B. E. Sunny, chairman of the executive committee of the National Electric Light association, has completed arrangements for the approaching convention and exhibition, and has performed his work so well that he is entitled to the thanks and praise of the organization. The arrangements for this meeting, the most important in the history of the association, could not have been confided to better hands. The management of the affair was conducted with the same wisdom and energy that has been displayed in everything that Mr. Sunny has undertaken. He has been a successful business man, but his success has been due to his own untiring efforts.

Mr. Sunny is still a young man, as the accompanying portrait indicates. He was born in Brooklyn, N. Y., and is 32 years of age. He began life as a telegraph operator in New York city, and after three years' experience removed to Chicago in 1875, where he secured a position with the Atlantic & Pacific Telegraph company. The following year he was promoted to the position of night manager, and here his ability and industry were soon recognized. In 1877 he was appointed manager of the Chicago office, and continued in that position until the Atlantic & Pacific company passed under control of the Western Union Telegraph company, in 1879. On his retirement from this position he became superintendent of the operating department of the Bell Telephone company's exchange in Chicago. When the contest between the Bell and Edison companies ended in a victory for the former, in 1881, Mr. Sunny was continued as superintendent of the operating department of the consolidated companies, and five years later was also given direction of the construction department. January 1, 1888, Mr. Sunny was elected president of the Arc Light & Power company of Chicago, and still retains that office. He has also been connected with the management of the Thomson-Houston company since Dec. 1, 1888. He has held the office of president of the Bookkeepers' Building association of Chicago for four years.

Mr. Sunny's business ventures have been uniformly successful, and they have demanded a large portion of his attention, but he has succeeded in finding time to devote to the cultivation and enjoyment of social relations. His courteous and considerate manner has won for him respect and admiration equal to the consideration due to his successful business career. The National Electric Light association was fortunate in enlisting his services as chairman of the executive committee, and it is under great obligations to him for the faithful and able manner in which he conducted its affairs.

Rapid Transit in New York.

David King, the builder of the Equitable building and projector of many other equally extensive enterprises in New York, has been seriously considering the question of rapid transit in the metropolis, and presents the following proposition as the result of his investigations: "The plan most favored and which promises best results from every point of view is to acquire by purchase or condemnation a strip of land of sufficient width for the construction and operation of four tracks from one end of the city to the other; to construct the road-bed just far enough beneath the surface to pass under the cross streets, and to erect on the property so acquired fire-proof buildings, leaving an open arcade on the level of the streets for pedestrians, with shops occupying the buildings on each side, similar to those on the 'passages' in Paris, with the upper stories devoted to offices or apartments. The road bed being on solid ground, trains could be operated without limitation of weight of engines and consequent number of cars, and at a speed equal to that of any first-class surface road. Having four tracks, two could be used by express trains making few stops, and two by local trains stopping frequently, thus attaining actual rapid transit. Owning all the property above the railway, ventilation could be perfectly accomplished and electric lighting of the cars would make them as comfortable in that respect as if the road were above ground, while the entire roadway and equipment would be sheltered from the weather and the attendant dirt and wet during the inclement season. The rapid advances being made in the use of electricity as a motive power render it reasonably certain that no steam locomotives would be necessary, thus greatly simplifying the question of ventilation. Instead of disfiguring the streets with unsightly structures, the railway is wholly concealed from view and the architectural appearance of the city vastly improved. It is the intention of gentlemen interested in this project to acquire the necessary property in two blocks and at once commence the construction of a section of the road."

B. E. SUNNY.

Electric Light Convention.

The preparations for the National Electric Light Association convention, at Chicago, February 19–21, have been completed, and everything is now in readiness for the opening of the proceedings. This meeting will undoubtedly be the largest representative body ever gathered in a convention of this kind. It will be of more than ordinary interest to those concerned in electrical matters in the northwest, as it will give them an opportunity of displaying what has been done to advance electrical matters in the west. Many important matters will be considered at the convention, and a number of able papers have been prepared by experts on various subjects. It is quite probable that the all important question of insulation will be discussed. At any rate there will be plenty of important matters to occupy the attention of the members.

The display of electrical appliances will outrank any that has ever been seen in this country. The Exposition building, in which the convention and exhibition will be held, is admirably adapted to the purpose, and the exhibitors will have ample opportunity to display the merits of their contrivances. Cuts are presented herewith illustrating the ground plan of the hall in which the exhibition will be held, and the space allotted to each exhibitor.

The resident members of the executive committee will entertain their associates and the other officers of the association at the Union League, Monday evening, February 18th. At 6 o'clock dinner will be served, and at its conclusion there will be a business meeting of the committee.

B. E. Sunny, chairman of the executive committee of the National Electric Light association, states that the final preparations for the convention are almost completed. A large force of men is now at work at the Exposition building. Apparatus from exhibitors has already been received, and the booths are nearly ready. The tickets are ready for distribution, and electric lights for the illumination of the building are being put up. Both arc and incandescent lamps are used, and there will be an especially fine display of lights in the assembly room. The press room is next to the assembly room, and has been divided into four compartments, and the different electrical papers will be accommodated in those four divisions. The regular cloak room of the building, which is just across the main hall from the electric light exhibition rooms, will be utilized for the accommodation of wraps, and check boys in the uniform of a local district telegraph company will be on hand to check and take care of wraps. As every one knows who is familiar with the Exposition building, the electric light exposition rooms are in two sections. The heavy fast-running machinery will be confined to one of those sections, which the executive committee has named Department A, and the lighter exhibits will be shown in the other section, which has been named Department B. Every foot of space at the disposition of the committee has been taken, and there will probably be an overflow of exhibits in the main hall, which is, of course, unheated. The railroad track, of course, is also located here. There certainly has never been such an Electric Light Convention as the Chicago convention will be in point of exhibits, and indications point to the largest attendance in the history of the association.

Petroleum as fuel will be the theme of two or three papers, and several speakers will be prepared to touch upon its relation to the other engineering problems of central station electric lighting. The subject of current meters will be treated in two papers, and it is reported that several distinguished electricians will participate in this discussion. The question of static charge on, and the puncturing of, underground cables, which received considerable attention at the New York convention, will be the subject of a paper at Chicago. The relation of the material of conduits to the insulation of cables will be the theme of one paper. The subject of municipal lighting will receive considerable attention. There are five committees that should report at Chicago. At least one of them is doing very good work, and its report will be interesting.

The assembly room in which the sessions of the convention will be held is a spacious apartment admirably adapted to the purpose. A

[illegible] at the south end the room, and chairs arranged in the body of the apartment.

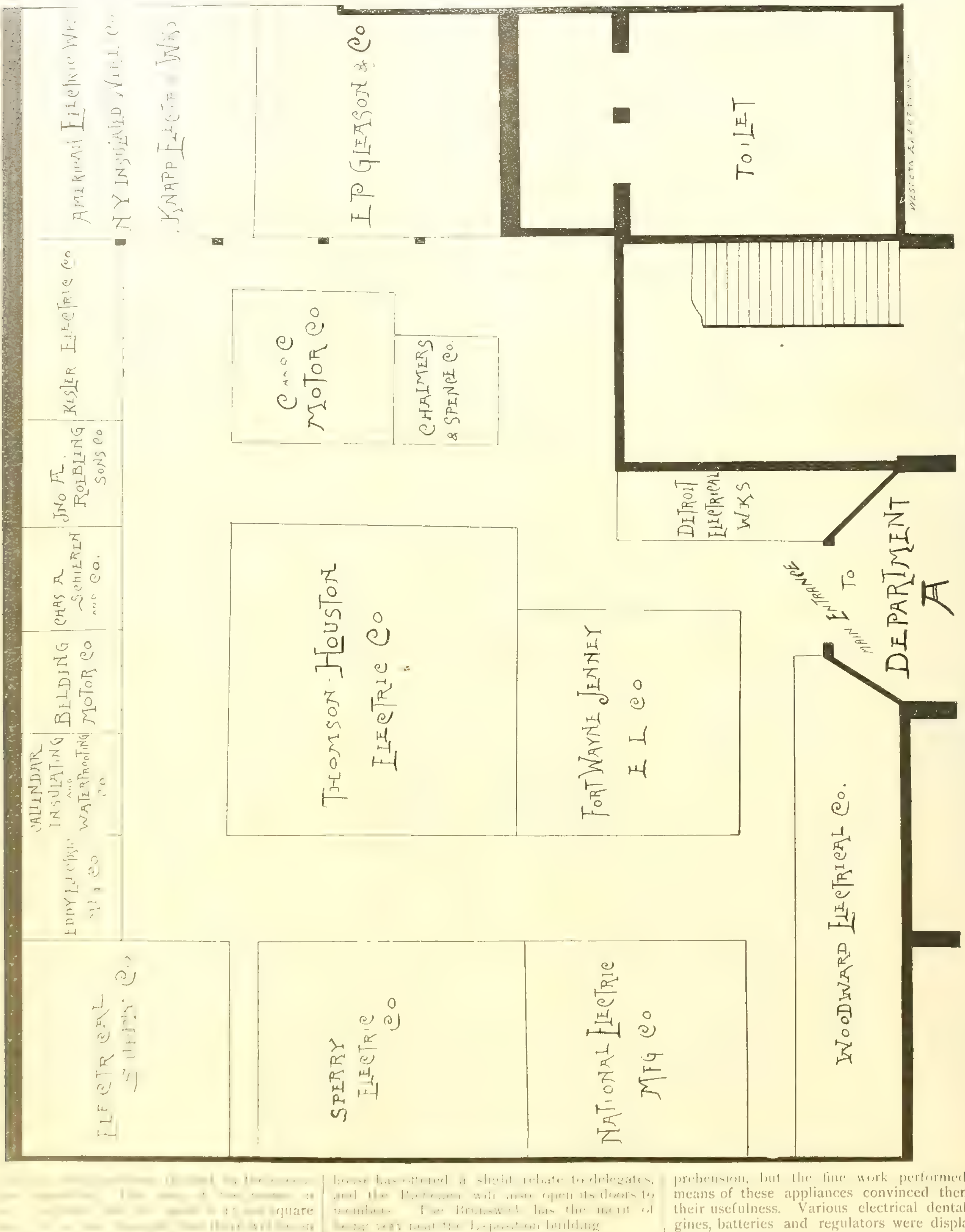
Excellent arrangements have been made for the accommodation of representatives of the press, and every facility will be afforded them.

The principal display of electrical goods will [illegible] made in the dining and art rooms, the floor

tical operation of an electrical railroad, furnished with every modern improvement. The track is 900 feet in length, and has a 50-foot curve.

No single hotel will accommodate all the delegates. It is probable that the greater number will go to the Leland and Grand Pacific, which are near the Exposition building. The Palmer

appliances by the S. S. White Manufacturing company of Philadelphia. Visiting dentists who were unacquainted with the "new fangled notions" looked on with amazement as Dr. E. T. Starr, the representative of the company, explained the workings of the intricate machinery operated by electricity. The electric mouth lamp and laryngoscope were beyond their com-



NATIONAL ELECTRIC LIGHT ASSOCIATION—FLOOR PLAN, DEPARTMENT A, SHOWING LOCATION OF EXHIBITS.

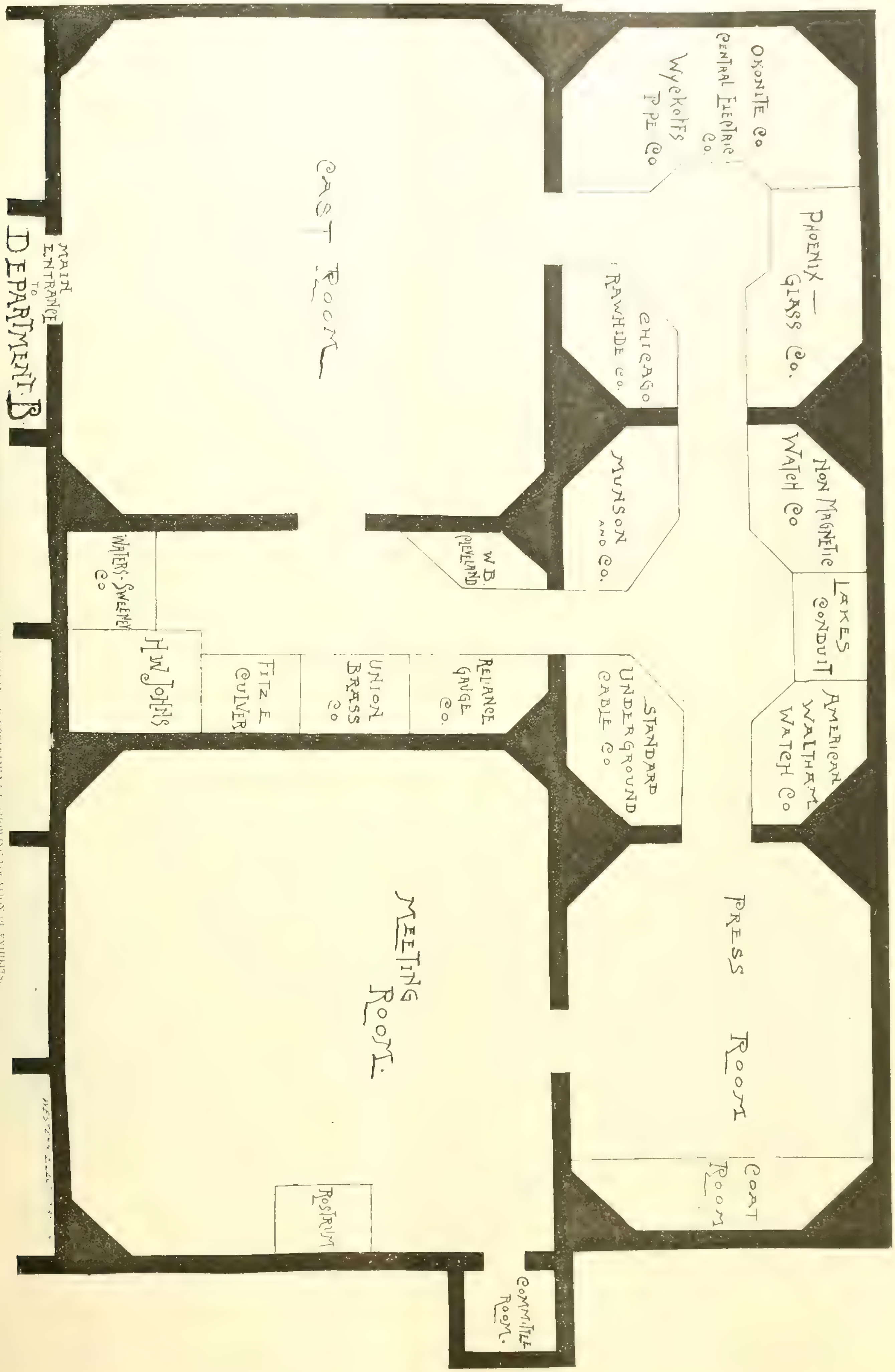
[illegible] square [illegible] ompleted. This [illegible] ee the prac-

house has offered a slight rebate to delegates, and the [illegible] will also open its doors to members. The Brunswick has the merit of being very near the Exposition building.

Electrical Dental Appliances.

An [illegible] feature of the Chicago Dental [illegible] twenty-fifth anniversary, meeting was the display of electrical dental

prehension, but the fine work performed by means of these appliances convinced them of their usefulness. Various electrical dental engines, batteries and regulators were displayed and explained. The electro-magnetic mallet, electrical otoscope, dento-electric cautery, electro-cautery snare, and many other appliances were operated, and their superiority attested. The establishment has branch houses in New York, Boston, Chicago and Brooklyn.



NATIONAL ELECTRIC LIGHT ASSOCIATION.—FLOOR PLAN OF DEPARTMENT B, SHOWING LOCATION OF EXHIBITS.

The Improved Sperry Arc Light System.

The Sperry Electric company of Chicago has introduced many important improvements in its system since it began manufacturing arc light apparatus. Many of these improvements are [illegible] illustrated in this article, and [illegible] system, as well as the [illegible].

Figs. [illegible] represent the Sperry armature, which is of the [illegible] type. All the wire which

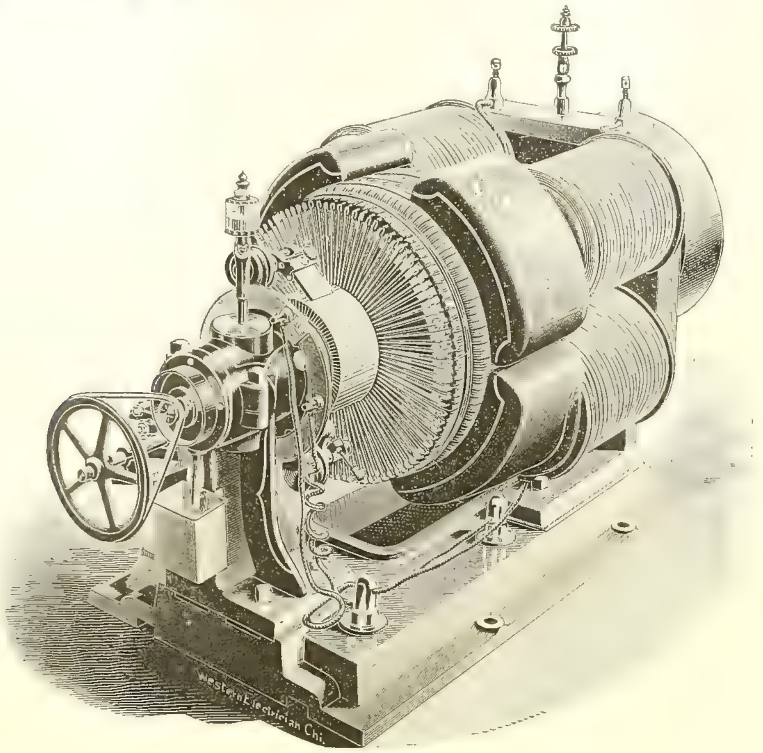


FIG. 1. SPERRY DYNAMO.

is wound upon this armature is at a considerable distance from the shaft, and, therefore, can be given a great peripheral velocity with a comparatively small number of revolutions of the armature per minute. The mode of support of this armature consists in spreading it from one of its free ends to a gun-metal spider, which is securely fastened to a steel spindle, forming the shaft of the machine. The great advantage of pieces, the output of electrical energy is greatly increased. It is said that 92 per cent. of the armature wire is thus rendered available for the actual production of the current. Another valuable feature of the annular armature is the fact that each coil is absolutely separate and distinct from the other. In case of injury to one coil it can be very easily repaired without necessitating the unwinding of the whole armature.

Fig. 1 represents the complete Sperry dynamo. Its mechanical construction shows the skill of its designer. The armature, for instance, may be rapidly withdrawn for purposes of cleaning, inspection, etc., by simply withdrawing the front journal together with the shaft. A special

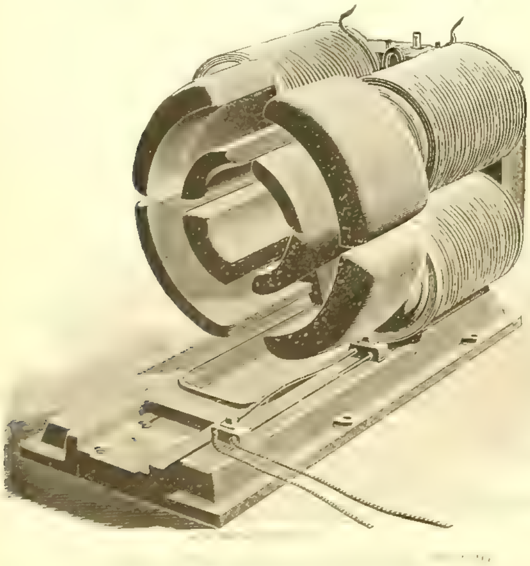


FIG. [illegible]

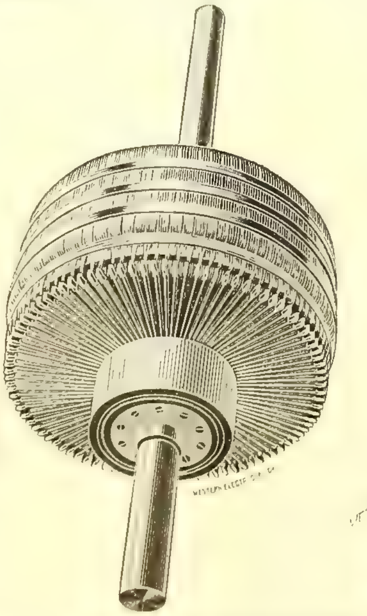


FIG. 3. ARMATURE OF THE SPERRY DYNAMO.

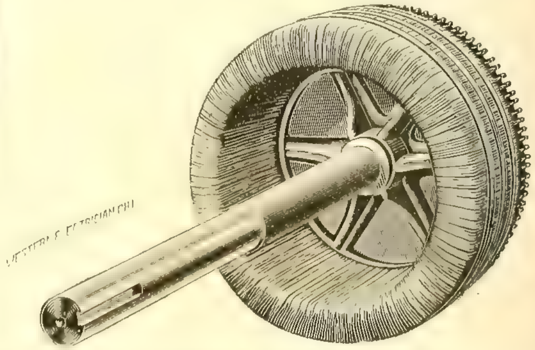


FIG. 4. ARMATURE OF THE SPERRY DYNAMO.

[illegible]

feature is the automatic regulator. The brushes consist of overlapping flat copper strips attached to a movable yoke. This yoke is connected by means of an arm to an electro-magnetic regulator placed in the ampere circuit. Any variation in the electrical resistance of the lamp circuit [illegible] the [illegible] of the electro-magnet. By [illegible] this movement adjusts the [illegible] in proportion to any [illegible] in the resistance of the lamp circuit. [illegible] that 75 per cent of the total [illegible] lamps may be instantly [illegible] without the least danger to the machine. This, of course, is a very valuable feature, especially for central station lighting.

Figs. 5 and 6 illustrate the Sperry arc lamp. It is graceful in design, and can be cleaned and attended without inconvenience. Each lamp is provided with an ordinary hand switch, and also with an automatic cut-out, which operates in case the carbons are burnt out or the arc elongates from the imperfect working of the mechanism. The regulation of the lamp is such that the carbon rod is made to automatically move in both directions. When the lamp starts the normal arc is at once secured and maintained throughout the entire operation. Dynamos and lamps are made for high or low tension.

Fig. 7 represents the Sperry lightning arrester. It serves for the discharge of static electricity from the line, whether produced from lightning or frictional electricity from the belts. If an arc should be formed between the plates they will be separated automatically, and then go back in the old position, ready for a new charge. This arrester has been described in detail in the Western Electrician on page 148, Vol. I, in a paper read before the Chicago Electric club by Mr. Sperry.

Electricity in the University of Rochester.

BY OTIS H. ROBINSON.

Teachers of science in the colleges have been for the last decade or more at their wits' end to know what it was best to do for their classes. The time allotted to natural philosophy and astronomy is in most cases no greater than it was twenty-five years ago. The acquiring capacity of the student is no greater. But these sciences have progressed, and are still progressing at a rate unparalleled in history. With such a state of things you may think of us looking out from our class rooms almost in despair at the extent of the field our courses are now expected to cover. A chapter from my own experience may interest those who were students here, and perhaps some also who were in other colleges twenty-five years ago.

Look at the sciences of magnetism and electricity alone. At that time these subjects very properly occupied a small place in a general course of study. The magnetic needle had to be described and its uses pointed out, and also the formation and action of an electro-magnet. Very little time sufficed for this. Electricity, frictional, voltaic, magnetic, atmospheric, etc., could be dispatched in a few lessons; for when the public took very little interest in the subject the work done was little more than mere definition and description. With a few exceptions the instruments in use were designed to startle and entertain the classes, rather than to illustrate and impress upon the mind the difficult principles of the science. Think of the painted images dancing between two plates, or of the ringing of a chime of bells, or of the illumination of bits of tin foil forming "magic squares," all to illustrate the discharge of a Leyden jar. What an abuse of time and opportunity! Attention was distracted instead of being fixed upon the phenomena with their causes and their manifold relations and laws.

These subjects were in those days very unsatisfactory ones to teach. The difficulties were very great—too great for the average student to undertake—so much remained unknown that there was an awkward vagueness in the discussions of the known. Failure, total or partial,

was written on a great part of the efforts to make these sciences useful. And besides all this we were dealing not with such phenomena as those of light, and sound, which we have al-ways before us, but with those which seemed to be dragged in from obscurity to perplex a little, and to astonish and entertain a little, and then to be lost sight of again.

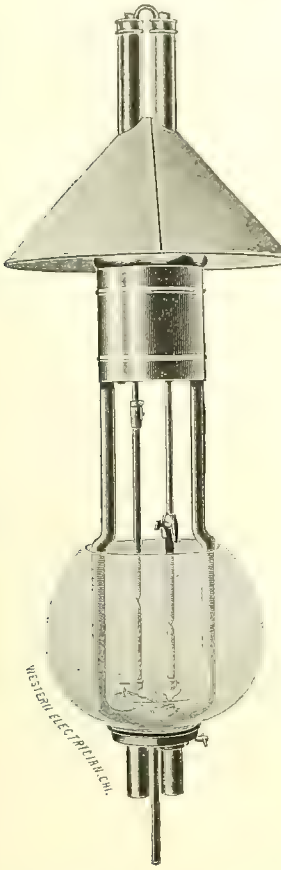


FIG. 5. SPERRY DOUBLE CARBON LAMP.

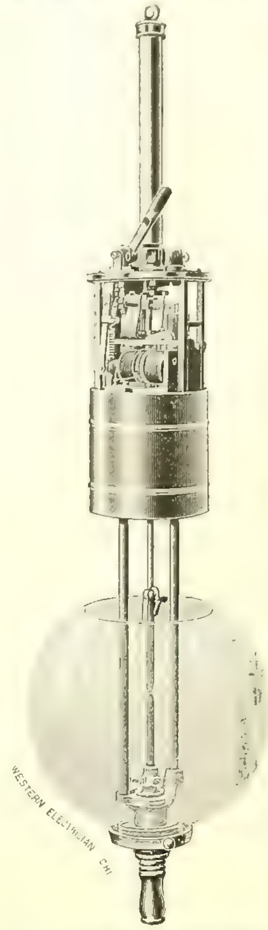


FIG. 6. SPERRY SINGLE CARBON LAMP.

To-day all this is changed. It is true there are great difficulties and many unsolved problems, but the boundaries of our knowledge are more sharply defined. What is within the reach of students the students have a healthy ambition to reach. A spirit of inquiry, stimulated by the modern improvements in the telegraph, by the motor, the light, the telephone, and many other new uses of electricity, keeps up the interest from first to last. Students inquire, on entering college, how large a course is given in electricity. Even the [illegible] difficult work of exact measurements and the solution of problems become [illegible] interesting in view of their practical importance. Moreover, students see now what they did not see in electricity a few years ago—a field for a career in life. The study of a science for the sake of the science is unquestionably a good thing; but there is nothing to awaken a general enthusiasm over a subject like seeing men acquire fame and fortune in the pursuit of it.

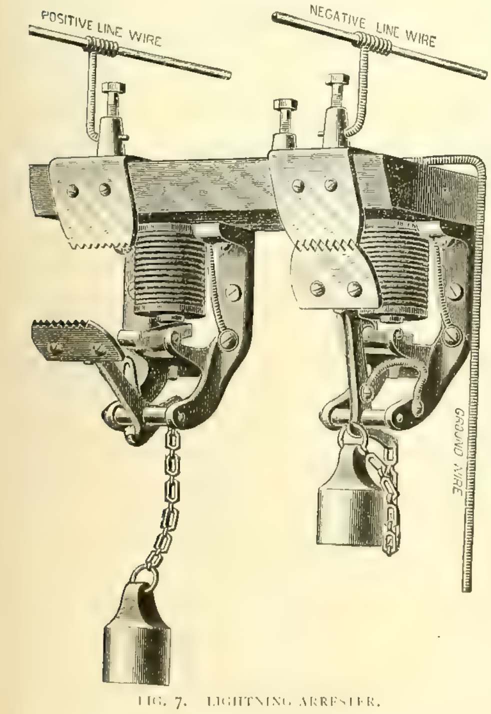


FIG. 7. LIGHTNING ARRESTER.

But it was my purpose to tell you what we are doing to bring our course of study up to date in respect to these sciences. With the limitation in time we cannot do very much. Indeed the time taken for them has been mostly stolen from the other branches of mechanics and physics by squeezing out the less important topics. The weeks thus saved suffice to teach by textbook and lecture the fundamental principles and the chief successful applications, together with some exercises in exact measurements. Until recently our instrumental illustrations were very limited, for our instruments were old and poor, and chiefly of the entertaining kind. Now, however, we are buying new instruments of the best kind, right up to date, as fast as they can be well utilized in the class-room. This we hope to continue. We have as yet formed no classes for laboratory practice. This may come in time. All we can do at present in this direction is to set apart certain hours of the week in which students can handle the instruments, and make their own experiments under supervision. Work beyond the prescribed course is encouraged by assigning subjects for examinations on which honors or prizes are awarded.

There is probably no department of a college course in which the professor finds it so hard to keep himself informed of the real progress which is being made as in the sciences we are considering. There are so many unsettled questions, so many theories afloat, so many devices which the popular writers call "discoveries," so many valuable applications, and with all the rest so much really good work being done in the laboratories, that one has to keep his eyes and ears open on all sides, every day in the year, or he will fall behind. In this part of my work I

[illegible]

The United States Electric Lighting Company and the Cook County Contracts

The contract for increasing the electric light plant at the Cook County court-house, Chicago, has just been awarded to the United States Electric Lighting company, through C. C. Warren, western manager. The increase of the plant amounts to 5[illegible] lights, and as there were [illegible] lights in place before, the full capacity of the new plant will be 1,500 lights. The dynamos are to be exchanged for larger ones, corresponding in capacity to the increased number of lights, and additional wiring and lamps are to be put up to equal the full requirements of the plant.

Congratulations might possibly be in order concerning this award, as considerable significance attaches to it. It will be remembered that a large amount of the money due on the old contracts which the County of Cook made with the United States Electric Lighting company in 1885, for originally installing the county plants, had to be collected after a protracted law suit in the United States court. The reason of this was that a local newspaper with sensational tendencies had charged bribery in connection with the letting of these contracts. The newspaper, however, was never able to substantiate its charges, but did succeed in carrying matters to such a point that the county declined to pay the remaining amounts due on the contracts until the matter was settled in court. Manager Warren promptly carried the cases into court and won every one of them against the county. The county has, therefore, been obliged to adjust the claims satisfactorily to the United States Electric Lighting company, and the outcome of the suits was a decided triumph for Mr. Warren. The full vindication of Mr. Warren is, however, better indicated, perhaps, by the fact that the new contract mentioned above has been awarded to his company, notwithstanding all the suits and trouble which have occurred in connection with the old contracts.

Mr. Warren's undoubted business ability has its best illustration, however, in his conduct of the western business of the United States Electric Lighting company during the last five years and a half. Investigation shows that during that time 444 separate electric lighting plants have been installed, and the steady progress of the business is shown by the fact that it took three years and a half of hard work to install 187 of them, while 257 of them have been installed during the last two years.

Part of the credit of this record must be assigned, of course, to the able assistants with whom Mr. Warren has had the business foresight to surround himself, prominent among whom the name of Chas. D. Shain is particularly worthy of mention The excellent equipment and first-class facilities of Mr. Warren's office are of special importance just at present, in view of the recent combination which, it is not unlikely, will tax the requirements of the office to its full capacity. It is safe to predict, however, that the office will be equal to the emergency, and that its former excellent record will even be improved.

The Cushman Company Appeals.

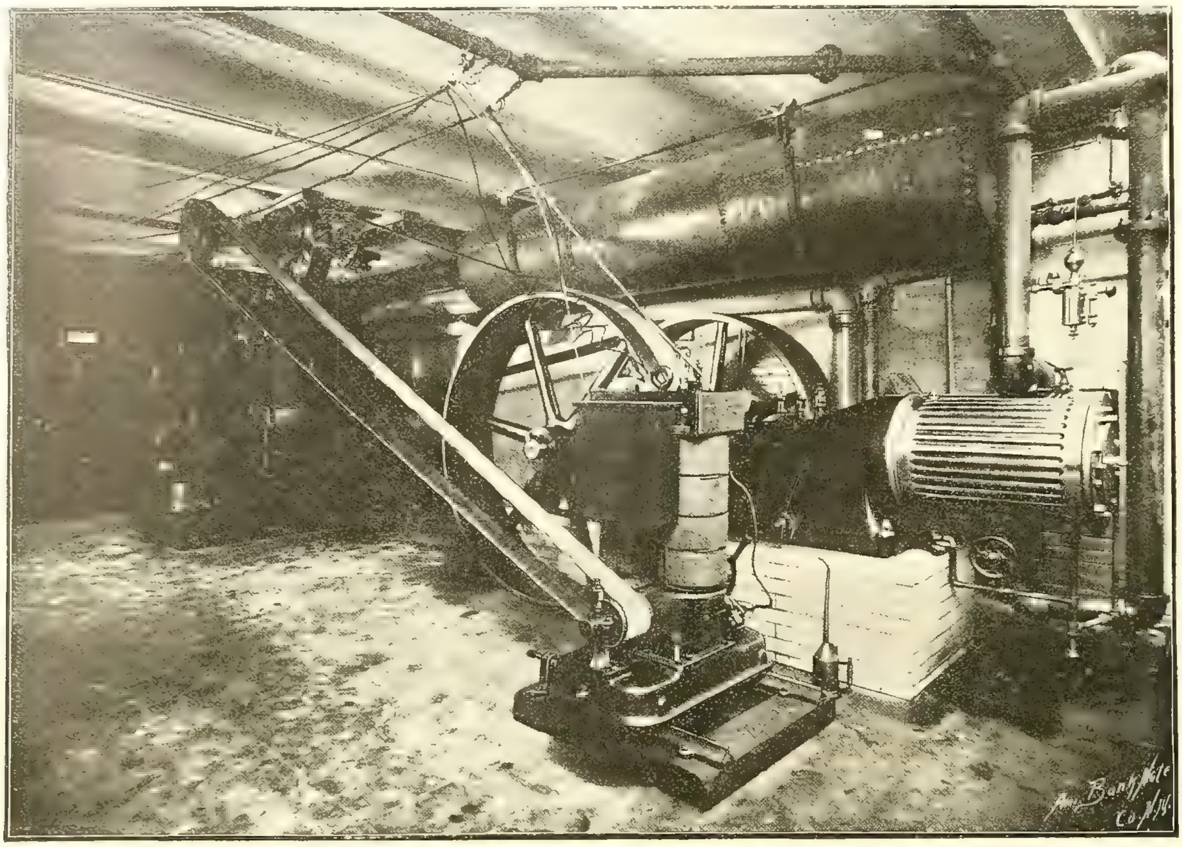
The Cushman Telephone company is still making a fight against the Bell Telephone company. The injunction recently granted the latter company by Judge Blodgett of Chicago was up for a hearing February 7th, and the attorneys for the Cushman company argued for its discontinuance, but this was refused. Cushman thereupon appealed, and the case will be presented to the United States Supreme court.

At Zanesville, O., the electric light company has made a proposition to the city council to furnish [illegible] Sperry lamp.

"C. & C." Company's Building.

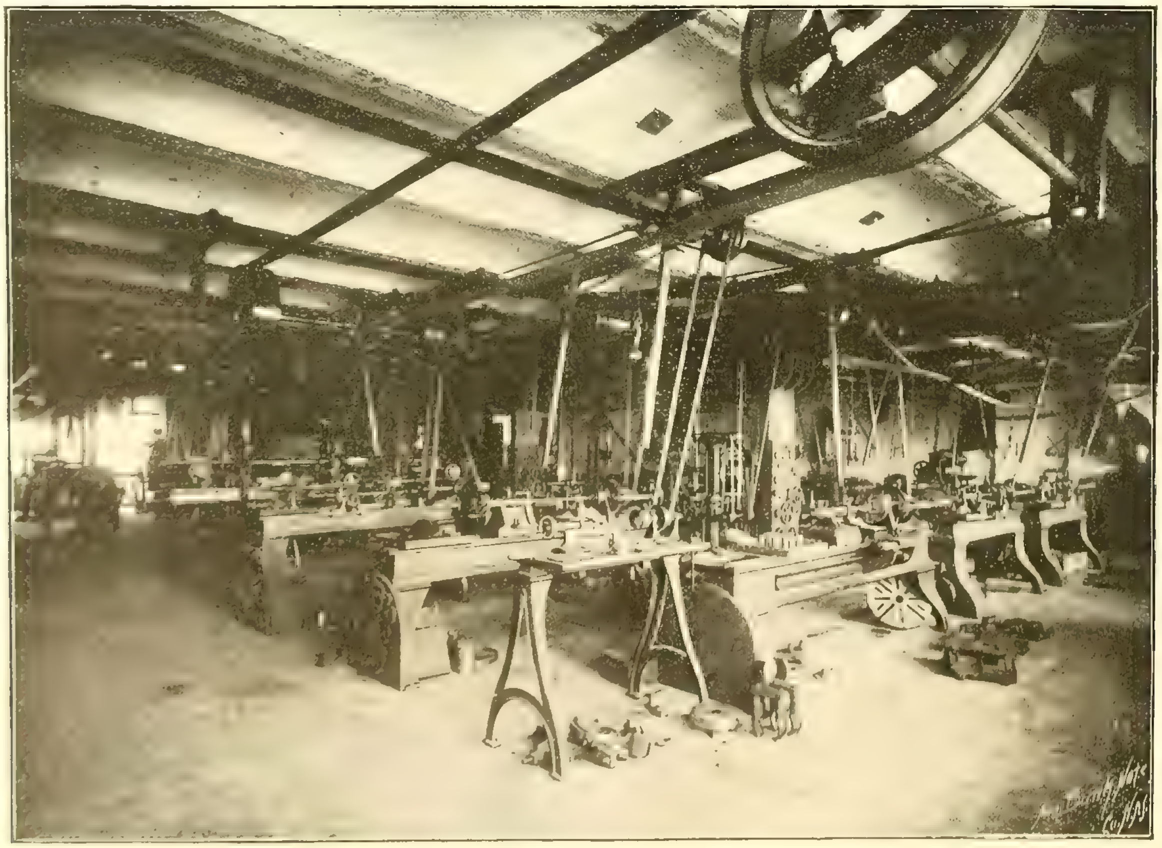
The new factory of the "C. & C." Electric Motor company recently opened in New York [illegible] the most elaborately appointed electrical establishments in the country. The dimensions of the building are 50 feet by 90 feet. The structure is of brick and iron, six stories in height and basement. It was con- [illegible] the floors [illegible]

The machinery in the building, illustrations of which are presented herewith, is operated by electricity. Conduits are built in the walls for conductors. The engine is a 12x12 Ball. One driving wheel is belted direct to a 50,000 watt Edison compound wound 220 volt dynamo, the other to a counter-shaft, from which is driven a 110 volt dynamo and an arc dynamo, from which [illegible] current of from 65 to [illegible] amperes may be obtained by [illegible] adjustment of the regulator. [illegible] lead to each floor, [illegible] power, are controlled from [illegible] the rear of the engine room. [illegible] load on the engine [illegible] per cent. less than would be required to operate the factory in the usual way by belting and shafting through the building from the engine room, according to expert engineers in factory construction. The establishment can furnish employment for 300 operatives.



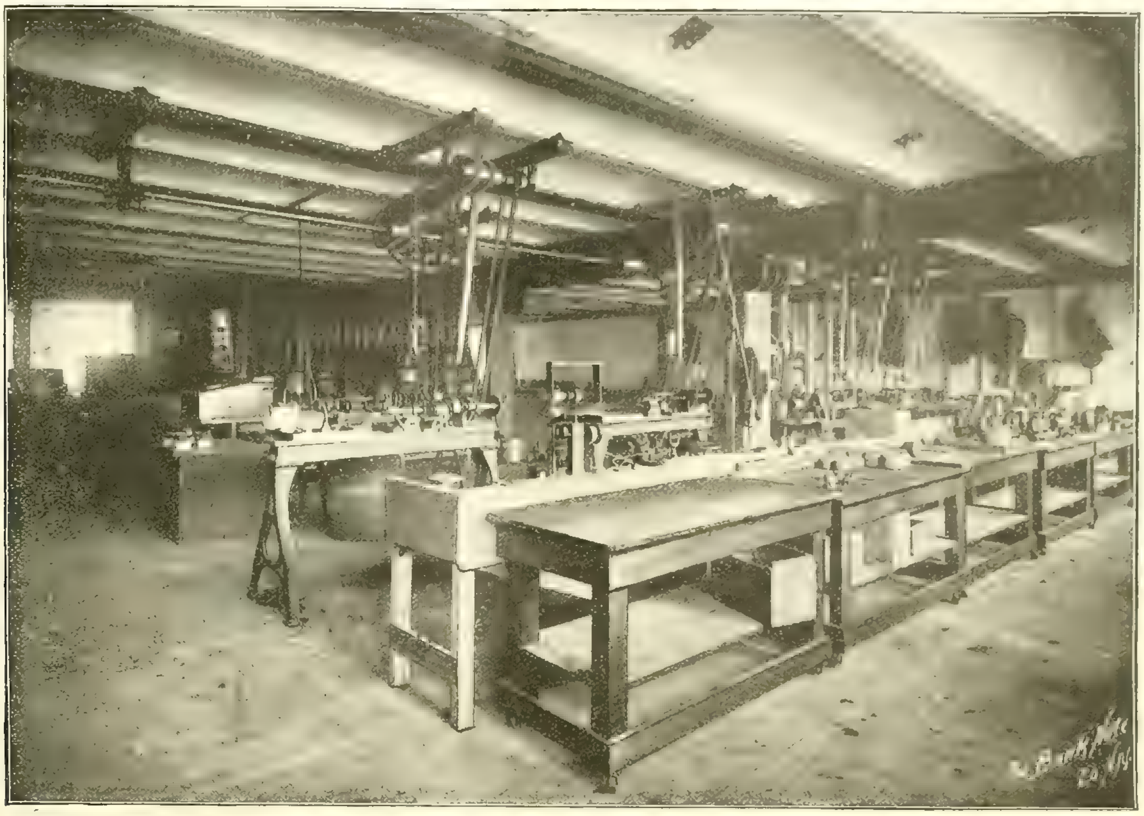
C. & C. COMPANY'S NEW BUILDING.

The mains from the 220 volt dynamo are connected by five-eighths copper rods to a pair of bus wires to the switch-board at the back of the engine room. From these bus wires are tapped off a separate set of feeders running to each floor in the building. The circuits from the 110 volt machine and from the arc machine are run to the testing department of the factory only.



[illegible]

One floor is used for battery work, and also for forge work, buff wheels, and other work of a dusty and dirty character. One corner of the room is fenced off for a packing and shipping department. Another floor is devoted largely to machine work, and has about fifty milling machines, drill presses, planers, lathes, power punches, etc. One boring machine on this floor is of sufficient clearance to turn off a 5-foot fly-wheel. This machine weighs about five tons, and is used for boring out fields, etc. This floor is operated by two electric motors of 4 horse power capacity each, and one of 1 horse power, making a total of 9 horse power. Another floor is devoted exclusively to the winding and assembling of the parts of motors. Here a 3 horse power motor drives the winding lathes, and a ½ horse power drives the emery wheel. On this floor is also the testing department, which is under the special direction of L. W. Serrell, the electrician of the company, and which is furnished with all the most recently devised and improved instruments and apparatus for delicate measurements. On the ground floor are the offices and show rooms.



C. & C. COMPANY'S NEW BUILDING.

The improved form of motor now manufactured by this company embodies the best mechanical principles in construction, while the electrical details are the result of long experience and careful study. The motor shown in the illustration is wound for 110 volt constant potential circuits, and is started by simply turning on the switch fastened to the front of the yoke, and stopped by turning it back again. The mechanical construction of these motors is as perfect as the best machinery and the most skilled workmen can produce, being interchangeable in every part. Great attention is given to accuracy of detail. The pedestals carrying the bronze journal boxes have every hole drilled in a jig; their upper surface is grooved and finished ready to receive the cap holding the journal boxes in place with one cut in a milling machine. All the caps are milled with another standard set of cutters, making it impossible for any difference to occur in any of them. Even the parts of the rocker arm carrying the brushes are milled with standard cutters, making them all exactly the same. The field magnets and yokes are finished in a similar manner, so that when the machines are assembled it is only necessary to take each piece indiscriminately out of a pile of finished parts and bolt them together, and we have the handsome and substantial milling machine represented in the illustration.

Insulation Resistance of Electric Lighting Installations and the Carrying Capacity of Electric Light Wires.

BY [illegible]

The question of insulation resistance [illegible] installations, under discussion at the Chicago [illegible] has awakened great interest in large circles; and although I have taken part in these discussions, I thought it might not be out of place to continue the discussion still further in the WESTERN ELECTRICIAN. The formula proposed for insulation resistance of low tension incandescent plants was:

$$R_1 = \frac{E \times K}{C}$$

where R_1 stands for insulation resistance in ohms; E for maximum electromotive force between the binding parts of the dynamo in volts, K for a constant to be determined and C for current in amperes.

The discussion of this formula brought out a good many opinions. The element C was severely attacked, and the members of the club were even warned not to accept the proposed formula, as the presence of the element C, it was argued, would place the club in a ridiculous light before the electrical fraternity. I still insist, however, that C should be included in the formula.

The Electrotechnical Association of Vienna issued new regulations for the safety of electrical installations. I quote rule No. 8, adopting, however, the symbols used in the United States: "The insulating resistance of a conductive net, as regards the earth or parts of the same circuit where differences of tension occur, must be at least

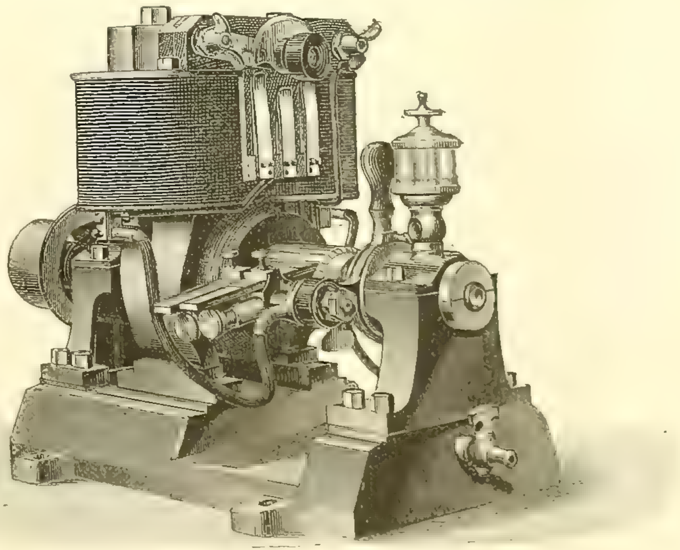
[illegible] ohm,

[illegible]

if, *a*, the conductor is carried exclusively over insulators, and in such a manner that there is absolutely no risk of fire in consequence of derivation or extension of the conductor, and, *b*, if in tensions of more than 150 vol s in alternating currents, or 300 volts in continuous currents, any accidental contact of persons with insufficiently insulated parts of the circuit is excluded."

I think C looks very well in the above formula. There is also an article in the Revue Internationale de l'Electricité et de ses Applications of January 5th, by Monsieur [illegible], on the same subject. Monsieur Picou reasons as follows:

"The insulation resistance R ought to be, in the first place, proportional to the maximum [illegible] of the dynamo. On the other hand, it is also [illegible] the more extended an installation is, [illegible] wires, the smaller should be the admissible insulation resistance. In fact, if we want to get an even [illegible] resistance per mile of wire, it is clear that the [illegible] resistance should be diminished as the number of [illegible] wire increased. A rule given for the insulation [illegible] per mile of wire is very good if we only want to test the insulation of the wire, but what we want to determine is not the insulation of the wire but the insulation of the whole network of wires put in place. In order to do this [illegible]



C. & C. COMPANY'S IMPROVED MOTOR.

mathematical accuracy it would be necessary to make two measurements—first, to ascertain the insulation resistance, an easy matter; second, the length of the wires, which is almost impossible. In this dilemma it seems preferable not to attempt to solve this problem with mathematical accuracy, but to adopt a hypothesis, which approaches the true [illegible]. The hypothesis [illegible] network of wires is in direct proportion to the current in amperes. If this is admitted our formula becomes

$$R_1 = \frac{E \times K}{C}.$$

Under the circumstances I hope the timid members of the Chicago Electric club will be able to stand the ridicule of adopting C in this formula. I will state that this formula was discussed before the club at the time of the appearance in Europe of the publications mentioned. As the club did not use the transatlantic cable during the proceedings it cannot be said that the opinions presented by the members were not original.

The rules and regulations of the Board of Electrical Con[illegible] New York, state [illegible]. The insulation resistance must be maintained in accordance with a standard to be not less than $\frac{1}{80}$ megohm or 12,500 ohms per mile per 100 volts. This rule was given for overhead conductors, but we may apply it to an isolated incandescent installation. Supposing we have an installation of 1,000 100-volt lamps; average length of wire per lamp 80 feet. The total length of wire would be 80,000 feet or about 15 miles. If we apply [illegible]

$$R = \frac{12{,}500}{L} \times \frac{E}{100},$$

in which L stands for number of miles and E for total electromotive force between the binding posts of the dynamo.

[illegible]

Now let us solve the same problem according to the [illegible]

[illegible]

[illegible] power lamp [illegible]

[illegible] the value of L. [illegible]

R per mile [illegible] ohms. A No. [illegible] B & S wire would answer. For conveying 100 amperes we would need a wire having [illegible] ohms resistance per mile, a No. 000 B. & S. wire would answer. This rule will work satisfactorily for overhead conductors, as one single conductor will hardly ever be called upon to carry over 200 amperes. The rule really amounts to this: The greatest permissible carrying capacity is about 1.2 amperes per square millimetre. In an article on "Carrying Capacity of Wires," published in the *New York Electrical Review*, May 7th,

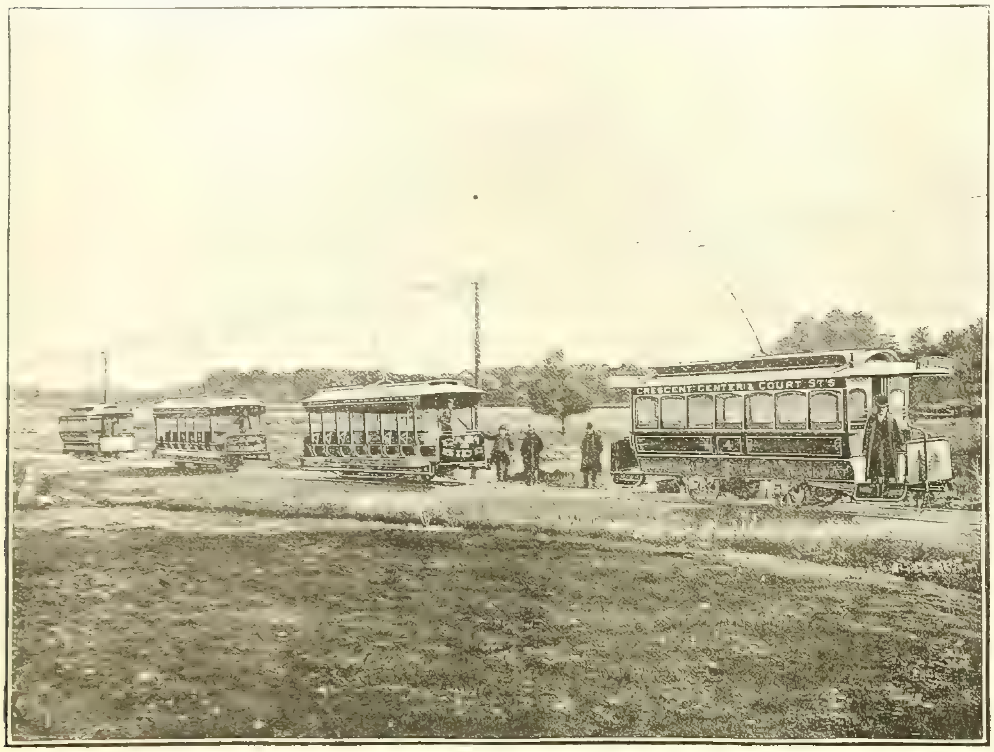


FIG. I. SPRAGUE ELECTRIC ROAD AT BROCKTON, MASS.

[illegible] for the safe carrying capacity [illegible] of larger diameter will heat more [illegible] carrying the same [illegible]

	Ampere per square millimetre.
Arc	2
Incandescent up to 50 lamps	3
" " " 100 "	2.5
" " " 300 "	2

I just noticed that Mr. H. Human, in the London *Electrical Review*, January 25th, speaks of the same facts in criticizing the Vienna electric lighting rules. I am also informed by the editor of the WESTERN ELECTRICIAN that the admirable paper of Mr. Jamieson on the "Insulation Resistance of Electric Lighting Installations" will appear in the same number of the WESTERN ELECTRICIAN as this article. I hope that Mr. Jamieson's paper will convert many members of the Chicago Electric club to my views concerning a formula for the insulation resistance of electric lighting installations. I will state, however, in order not to lessen the merits of our club discussions, which commenced early in December, 1888, that Mr. Jamieson's paper was read in England only Jan. 24, 1889.

Recent Sprague Electric Roads.

Several views of electric railways installed by the Sprague Electric Railway & Motor company of New York are illustrated in the accompanying cuts. The first two engravings show views on the East Side electric railway of Brockton, Mass., of which Albert F. Small is president. This road extends over a circuit of about four miles in length, operating four cars. The first engraving represents a test which was recently made upon the railroad, which consisted of bunching all the cars of the company at a point on the road farthest distant from the power house, and in starting them all up at once. The test was perfectly successful. Although the power for all the cars was transmitted between two and three miles the cars started up promptly, and moved rapidly, showing that the entire power can be easily transmitted and applied even at the farthest end of the line, and that the load upon the dynamos can be varied from zero to a maximum without any resulting detriment to the electrical apparatus.

The second view gives a very good idea of the bracket method of suspension used upon this line, and also of the Sprague overhead system of reinforcing the conductor. By this system the working conductor, a silicon bronze wire of small diameter, is carried over the center of the track, while the greater portion of the current is carried upon a main conductor running parallel to the working conductor, and connected to it

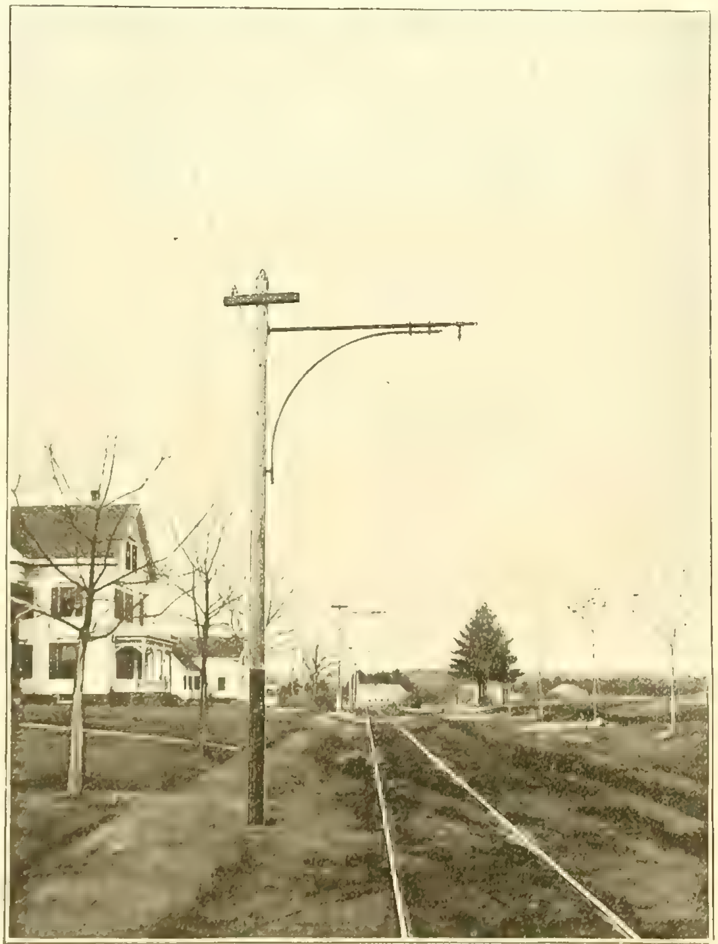


FIG. 2. [illegible] ELECTRIC ROAD AT BROCKTON, MASS.

every 100 or 200 feet. This main conductor, which can be either carried underground in a subway or at the side of the street, as in the view, can also be reinforced by feeders running from the main power station. The size of the working conductor is independent of the number of cars and the length of the line, and therefore no changes are required by extension of road or increase in number of cars. The electric road at Brockton has been in operation now for about four months, and it is giving very good satisfaction to both the directors of the road and citizens of Brockton. The company does not own its power station, but secures its supply of current from the local lighting company.

The second road illustrated in these views is the East Reading railway of Reading, Pa. The cut gives a very good idea of the method of overhead wiring for a turn-out. The road is a single track road, extending over about two miles. The road has been in operation about two months.

The fourth engraving is a view of an electric car on the Wilmington City railway, which has been in operation upon the Sprague system for about eight months. This road has given such great satisfaction that the directors of the road have ordered an additional number of cars. In the letter to the Sprague company the president of the road, William Canby, says: "From the practical experience, we pronounce your system a complete success. We consider it by all odds the most economical mode of running street cars in suburban districts, or in any place where permission to erect poles can be obtained. In comparison with horse power we find it decidedly cheaper and more efficient in every way. It is popular with our patrons on account of its cleanliness, its smooth and rapid motion, and especially for the absence of the usually overtasked and laboring horse."

FIG. 3.—SPRAGUE ROAD AT EAST READING.

Regulating Telephone Rates.

The bill now before the legislature of Illinois providing for the regulation of telephone rates in this state is aimed principally at the Chicago Telephone company. This bill provides that it shall be a misdemeanor for any company to charge more than $6 per month in a city of 60,000 inhabitants for the use of a single telephone, $4 per month in cities and villages with a population of 25,000 and not more than 60,000, and $3 in all places of less than 25,000. The usual provision for communication between different cities and towns is also made—15 cents toll for the first five minutes' conversation, and 5 cents for each succeeding five minutes. A violation of the terms of this bill is punishable by a fine of not less than $200 nor more than $[illegible] for the first offense, and for the second offense not less than $[illegible] nor more than $1,[illegible], and for the third offense not less than $1,[illegible] nor more than $[illegible], and for every subsequent offense and conviction thereof shall be liable to a fine of $[illegible].

Senator Eckhart and Representative Baker announce their willingness to change the rate for cities of 60,000 to $7 per month, provided their associates desire such amendment.

The Ford bill, which is also under consideration, empowers city councils and boards of trustees to regulate telephone companies by ordinance.

New York Electrical Society.

A meeting of the New York Electrical society was held February 6th at the new factory of the C. & C. Electric Motor company in New York, on the invitation of the company. After preliminary remarks by President Pendleton, Harvey L. Lufkin said:

"Gentlemen: We are glad to meet you here, and in behalf of our company I desire to express to you our appreciation of the compliment you pay us and our new factory [illegible]

[illegible] direct and instantaneous control over the automatic valve gear [illegible] in the basement [illegible] the belt [illegible] this machine. We [illegible] using a milling machine. The piece being milled has finished its travel and the machine is stopped by shifting the belt to a loose pulley. A horse power [illegible] has been taken off the electric motor driving that machine, and the tension on the motor belt relaxes to exactly that extent. The counter e. m. f. in the armature [illegible] increases, and the horse power of current, which is no longer called for in the motor, the dynamo in the engine room ceases to generate, and the automatic valve gear on the engine immediately adjusts itself to a [illegible]. Every machine in our factory bears exactly this relation to the engine. Now, multiply the ¼ horse power hour saved in this machine (supposing it to be stopped [illegible] each hour) by, say, 50 machines running under the same average conditions, some requiring more and some less power, and you have a total of 12½ horse power hours saved each hour, or 125 horse power per day. Add this 12½ horse power to the 18 horse power, our average load, and we begin to approach the estimated load of our factory under former conditions of practice. To this we should add about 12 or 15 horse power, which would be necessary to drive a line of heavy main belting through the six stories of this building, and we have a gross result of from 42 to 45 horse power.

"We have wired up in the building a total of 220 lights, 212 16-candle power, four 20-candle power, two of 32-candle power, and two of 100-candle power. From 15 to 25 of these lights are used all day. About 150 to 175 are used about three hours during the day.

"Another great feature in this method of factory construction is the independence of each department. A breakdown at one, or a stoppage from any cause, has no effect on the other departments, each being connected directly to the engine room."

The visitors inspected the [illegible] and machinery and were greatly pleased with the attention and courtesy of the representatives of the company. A vote of thanks was tendered the C. & C. for its hospitality.

FIG. 4.—SPRAGUE ROAD AT WILMINGTON.

The release of the French copper syndicate [illegible] the output caused a decline in stocks, [illegible] gained its position, and although the report was widespread that the combination had virtually [illegible] more gave unmistakable evidence of reanimation.

Western Electrician:

EVERY SATURDAY.

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DEPARTMENTS.

[illegible]

WE particularly commend this issue of the WESTERN ELECTRICIAN to the careful perusal of our readers. It is, without question, the best number of an electrical journal ever published. [illegible] twenty pages or sixty columns of copiously illustrated reading matter, and the faith of the patrons of its business depart[illegible] thirty-four pages [illegible] advertising, representing the [illegible] journalism can offer a [illegible] it must not be forgot[illegible]

[illegible] at Chicago, February [illegible] practically [illegible] early and late to make the meeting of the utmost interest and benefit to the members of the association, and to Chairman Sunny particular credit is due for the success of the event, which is now assured. The exhibits will form a noteworthy feature of the convention. The demand for space has been beyond the anticipation of the committee. The committee has secured a large number of papers dealing with questions of the most vital importance to the electric light fraternity. That the attendance will be large goes without saying. The fact is that members cannot afford to remain absent from a meeting which promises to be of the most significant character. The committees and the local members of the association can be relied upon to make the stay of the visiting members interesting and profitable, and sustain Chicago's reputation for cordial hospitality. Do not miss the Chicago Convention.

TRAIN LIGHTING by electricity is occupying considerable attention just now, and in an interesting article in another column the development of this department is reviewed. The present method of furnishing current is described and illustrated. The subject is one that concerns all who are interested in electric lighting.

THE taxpayers of Lockport, N. Y., have decided to establish an electric light plant. The present contracts with the gas and electric light companies expire in April, and unless the new plant is completed in that time the city will be without light unless it pays "regular" rates to the gas and electric light companies.

THE marvelous extension of electric railways leads a contemporary to inquire: "Is this new stride in locomotion destined to revolutionize city travel as the steamboat did navigation? Is the electric car destined to cease to be a wonder, and become familiar to all? As the handsome car, filled with its human freight, reaches up its slender arm, lightly touching with its hand the wire that looks like a spider's silken thread, it spins away, over grades and around curves, obedient to the slightest gesture of the motor man, who knows not what force he commands. Wonderful, indeed, and sometimes frightful, seems this unseen power that lightly wafts the tons of weight along, but obedient and submissive is it to him who has read its laws. It is powerful, but to serve."

THE necessity of uniform insulation resistance throughout electric lighting installations is forcing itself upon all who are interested in electric lighting. The Chicago Electric club has devoted much time to this subject, valuable papers have been read before it, and the numerous points involved have been discussed in an able manner. Full reports of these papers and discussions have appeared in this paper, and in this issue two additional papers on this topic arepresented. One of these is a paper read by Prof. A. Jamieson before the Institution of Electrical Engineers, at London, and the other is by F. B. Badt of Chicago. Both of these gentlemen are recognized authorities, their views are presented in a concise manner, and are based upon practical experience and study.

OTIS H. ROBINSON contributes a paper on "Electricity in the University of Rochester" to this issue. Prof. Robinson, who is at the head of the department of mathematics and natural philosophy in the Rochester institution, has had exceptional opportunities to note the development of this branch of the scientific course in [illegible] of learning. His description of the [illegible] which this important topic was formerly neglected will prove interesting at this [illegible] solving this [illegible] The key to the [illegible] on this question [illegible] following sentence [illegible] ted from his admirable paper: "The study [illegible] questionably a good thing; but there is nothing to awaken a general enthusiasm over a subject like seeing men acquire fame and fortune in the pursuit of it." The article is of unusual interest, and will repay a careful perusal.

MEMBERS of the National Electric Light association and others who attend the convention will have an opportunity of inspecting the most extensive underground electric light plant established by any city in the world. This is not the only striking feature of the system in operation in Chicago, and the visiting electricians will undoubtedly find many admirable improvements and devices in Prof. Barrett's system that will prove valuable to them.

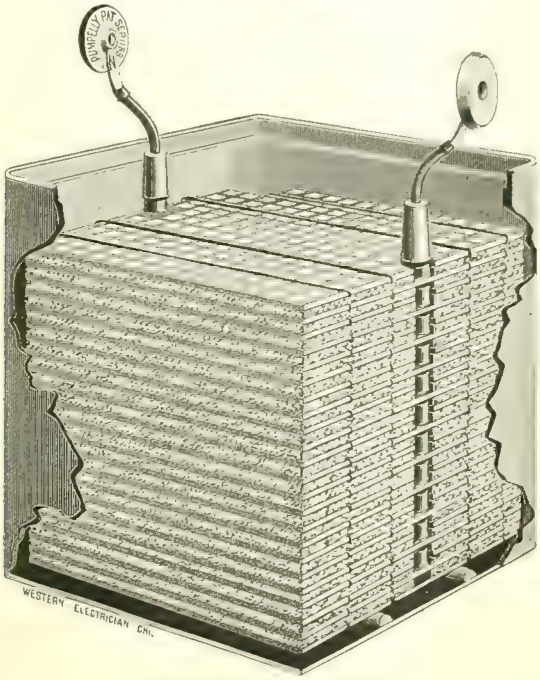
IT has become fashionable in certain quarters to assail telephone companies at every opportunity, and agitate a reduction of rates of service, and as is usual in cases of this kind, the opponents of the telephone companies indulge in wild statements, and advocate in many instances unconstitutional projects for the "crushing out of monopoly." Just at present the telephone companies of this state are under fire. Bills are pending before the legislature which, if enacted, will so reduce the income of the telephone companies throughout the state, as to make it undesirable for capitalists to engage in these enterprises, and in many cases it is claimed the returns would not pay the actual running expenses of the exchanges. In view of these facts representatives of the telephone companies announced that the passage of any of the proposed bills would necessitate their withdrawal from the state. This announcement was first met with an incredulous smile, but when it became evident that the companies were in earnest, those who were waging the telephone war began to look about them for means of thwarting the companies' designs. Possibly the most original methods proposed were those advocated by self-styled representative newspapers of Chicago. In advocating the passage of the bill establishing the rate of telephone tolls, the *Journal* urged also that the bill should be so amended as to forbid the removal of instruments by the telephone corporations from any town in consequence of the reduction of tolls. This is certainly an original idea, and worthy the source from which it emanated. The idea of compelling a man or a body of men to continue in a business that not only is not profitable, but that by reason of statuary restrictions has been made a losing investment, is preposterous. There is no danger, it can safely be said, that such an amendment will be considered even by the most rabid anti-telephone legislator in the state, but it serves to illustrate the unreasonable demands of many of these agitators. The *Morning News* suggests that a law providing that the withdrawal of service from any place because of such regulation of rates should work a forfeiture of the charter for the entire state would be valid and proper. This, too, is unreasonable and unjust. The telephone companies of this state are not under one management, and if the course indicated were pursued, those who could continue in the business would not be permitted to do so. It would also be unjust to the subscribers whom the bill is apparently intended to protect. Thus if the telephone company of a small town in southern Illinois should withdraw, it would be unjust to deprive the people of Chicago of the advantages of the telephone. But it is unnecessary to dwell further on this matter. The absurdity of the proposed "relief" measures are sufficient to condemn them in the minds of practical men. Another movement to empower city councils and village boards to regulate the affairs of local telephone companies is also calculated to retard the advance of scientific measures. It will not only affect telephone companies but all similar organizations, and have a tendency to demoralize them. Capitalists will not invest their money in enterprises that are liable to be handicapped and thwarted by the whims of an egotistical member of a town board or an aldermanic "striker." In these matters law makers should move slowly and always bear in mind the vast interests at stake in these enterprises.

The Pumpelly Storage Battery.

BY FOREE BAIN.

Like most important discoveries, the secondary or storage battery was discovered accidentally. About eighty years ago Carl Ritter, one of the greatest of modern geographers and teachers, while experimenting with what is now known as an electrolytic voltmeter, noticed that the voltmeter retained a charge of electricity after the primary current had ceased. The fact that Ritter's attention was more directly called to geography, his favorite study, probably accounts for his inactivity in following up his discovery. The fact remains, at any rate, that there was no practical use made of it until about 1860, when Gaston Plante enlarged upon the discovery of Ritter and produced what is generally known as the first storage battery, which bears his name, and to him the invention is generally credited. Plante's batteries are usually made of two sheets of lead placed one on top of the other, but separated by narrow strips of gutta-percha and then rolled up into a spiral form. They are placed in a glass jar or cup containing dilute sulphuric acid. This battery requires quite a period of time in which to "form" it. This is effected by a succession of charges, discharges and reversals. In 1850 Camille Faure announced his improvement in storage batteries, which consisted in mechanically coating both plates with red lead or minium, which he made into a paste and painted on the plates. This improvement reduced the necessary time for "forming" from several months to as many hours. It was found that while Faure's battery was a great improvement on anything previous, that it was not perfect by any means, as the active material would scale off and "local action" would decompose that which remained. J. S. Sellon, in June, 1882, produced an electrode, consisting of a support having perforations in which to pack the active material, and now this type of battery universally prevails.

The efforts of most electricians, whose attention has been turned in this direction, have been to reduce the weight of the cell and to increase the ampere-hours of discharge, and toward more convenient and economical means of manufacturing the batteries. It naturally occurs to one unacquainted with the nature and action of a storage battery that on this account a material or metal of less specific gravity than lead should be used. Untold numbers of able experimenters have for the past five or six years been devoting their attention toward the solution of this problem, but up to the present date the writer is not aware of a single instance where a successful storage battery has been produced in which electrodes other than lead have been used, and in which an e. m. f. equal to lead in proportion to weight and bulk, could be obtained.



PUMPELLY STORAGE BATTERY.

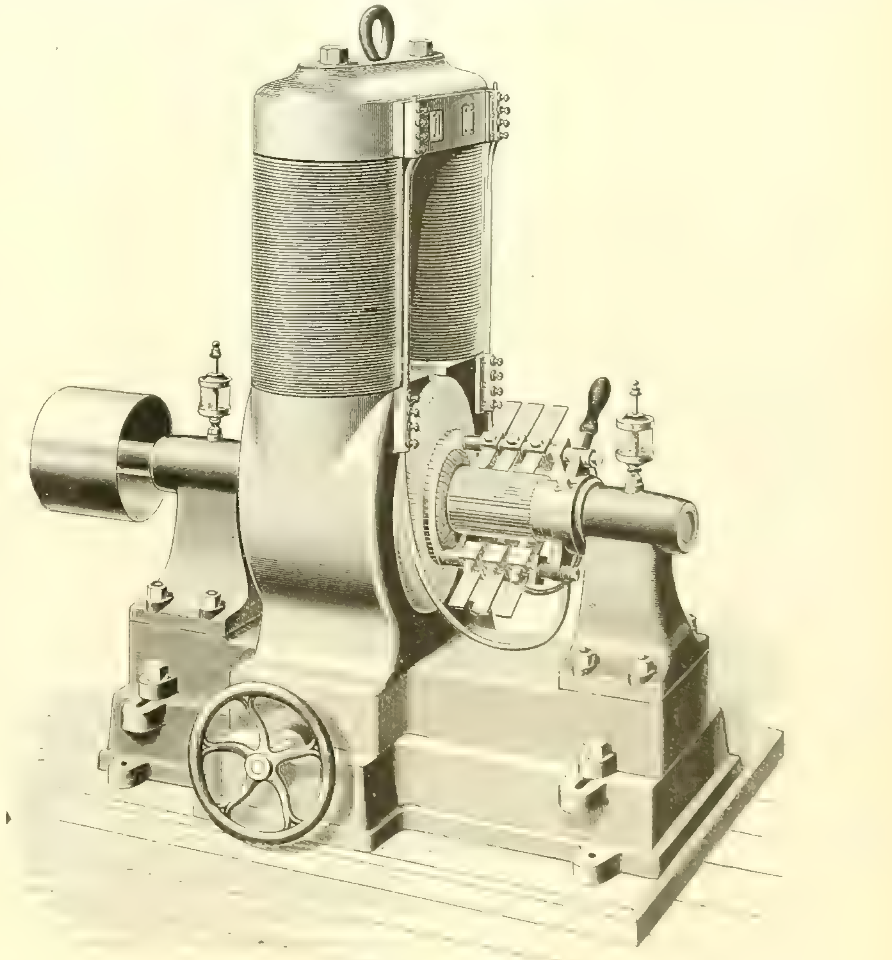
Almost any metal, or any two kinds of metal, may be placed in proper electrolytic solutions and form a couple by which electricity may be stored, or, more correctly speaking, by which a chemical action may be produced by a current of electricity, the *reaction* of which will produce a current of electricity.

As an illustration, suppose we place a zinc and a copper electrode in a solution of sulphuric acid. They both tend to combine with sulphuric acid, but they tend to set up e. m. f. in opposite directions, but the electromotive force of the zinc is higher than that of the copper, as zinc has a greater affinity for oxygen, and therefore the resultant e. m. f. is expressed by the

[illegible] while the interna[illegible] plane. Each plate has a ferrule cast inter-[illegible] Lead is then poured around the rod, which entirely covers it and thus protects the rod from the direct action of the acid. In this manner the plates are held firmly together, and a conductor is thus formed which has very low r[illegible]ance. The plates are of the gridiron pattern, composed of an alloy which is a departure from the lead plates, and is said to be superior for many reasons. The grids are so formed that the active material is dovetailed into the lead plate. There is a sheet of asbestos cloth between each two plates in the battery, which renders a short circuit impossible. The cell, which is illustrated, is composed of eleven positive and twelve negative plates, each 6½x6½ inches, and contained in a vulcanite case 8x8x10 inches. The cell complete weighs thirty-two pounds, and has a capacity of 250 ampere-hours, with an economical discharge rate of twenty-five amperes. The e. m. f. of each cell is two volts. The internal resistance of the cells while discharging averages .003 ohm. There are other interesting features of these cells, but the writer is restricted from entering into further description by the fact that they form subject matter for patents now pending.

Queen City Dynamo.

The incandescent dynamo herewith illustrated is manufactured by the Queen City Electric company of Cincinnati, O. The machine was designed and perfected by Lewis W. Davis, the electrician of the company. The armature of the dynamo is an elongated Gramme ring with



QUEEN CITY INCANDESCENT DYNAMO.

laminated wrought-iron core, mounted upon a brass spider, and steel shaft running in gun-metal boxes. With the exception of several of the smaller sizes, the coils consist of a single layer of double cotton-covered copper wire, which completely covers the surface of the armature core. The spider is rigidly held in [illegible]

with stop cock for drawing off the drip oil. These tanks being completely covered by the pillow blocks, it is impossible for any foreign matter to enter the oil, which, after filtering, may be returned to the oil cups and used again. The commutator consists of forty-eight copper segments accurately fitted and carefully insulated. The coils enter suitable slots in each segment and are firmly soldered.

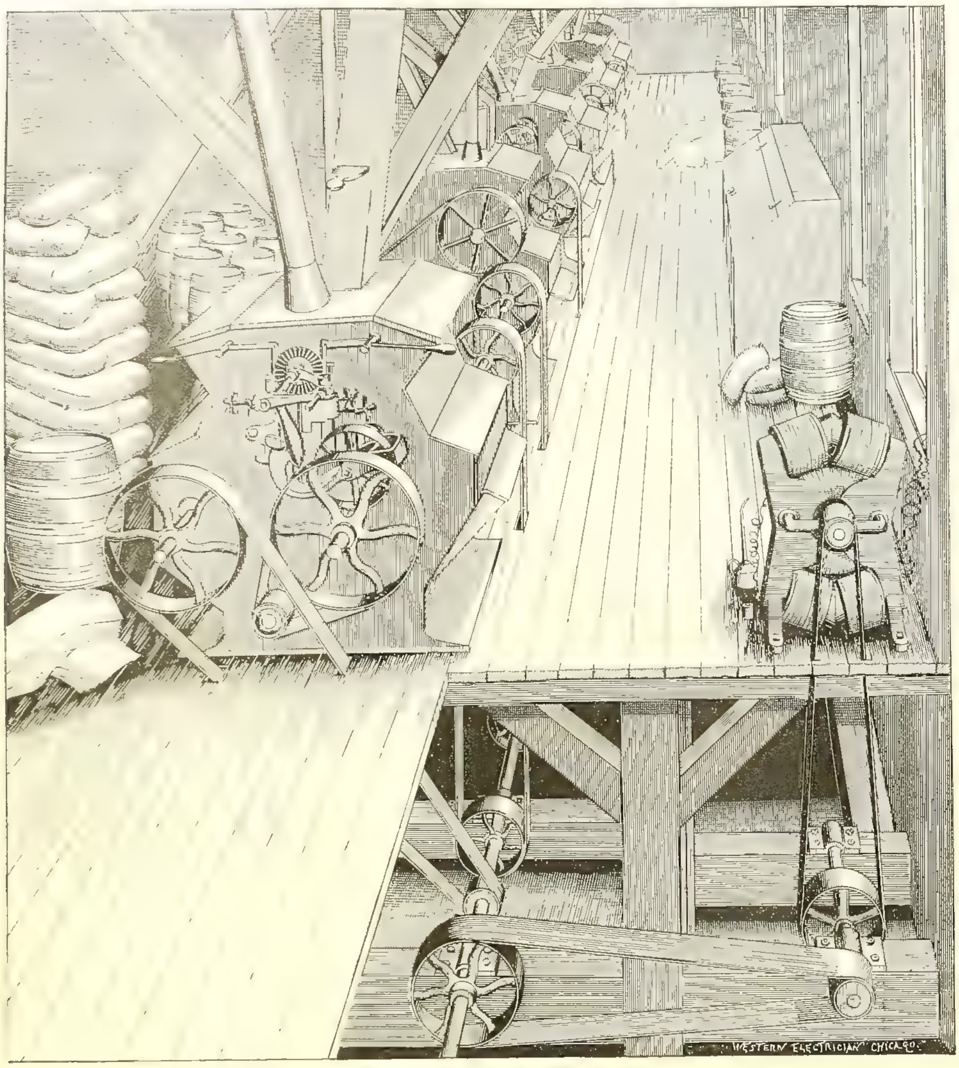
The base of the machine is of cast iron, [illegible] in two parts, carefully planed and scraped, guides being used which provide means for "lining up," no matter how often it may be necessary to slide the machine forward and back upon the sub-base. Substitution of iron for wood in the construction of the base is done at a considerable advance in cost, yet it is a decided advantage oftentimes to slide the machine readily, without recourse to any pries or jackscrews. Incidentally, it may be mentioned that magnetic lines of force exist to so small an extent in this sub-base that it is impossible to cause the smallest cambric needle to cling to it.

The field magnets have Norway wrought-iron cores, and the wire is wound upon bobbins that are easily slipped on and off the cores, for ease in shipment—a great desideratum in mining districts, or for erecting machines in upper stories of buildings without hatchways or elevators.

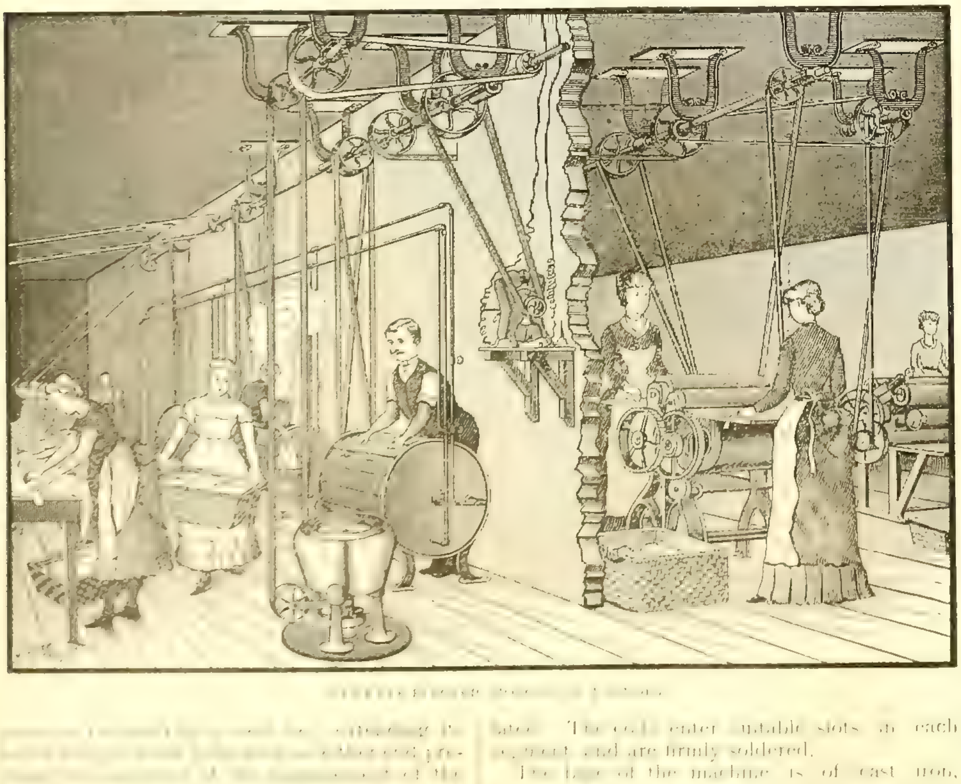
The machine is so arranged that it may be shipped "knocked down," and easily reassembled at its destination.

The dynamos for low tension, direct incandescent work are ordinarily wound for a potential of 110 volts, and armature speed of from 700 to 1,000 revolutions per minute. Their regulation is thoroughly satisfactory.

At the Exposition of the Ohio Valley, held in Cincinnati last summer, two of these machines, with a capacity for 500 15-candle power lamps each, were assembled for the first time in the exposition building. They started with nearly 900 lamps in circuit, and the number was soon increased to 1,015. The dynamos were run 110 days for six hours daily, and burnt out, during this period, seven lamps. The company had also on exhibition one 50-horse power generator, and one 25-horse power, and twenty-seven other motors in different parts of the building.



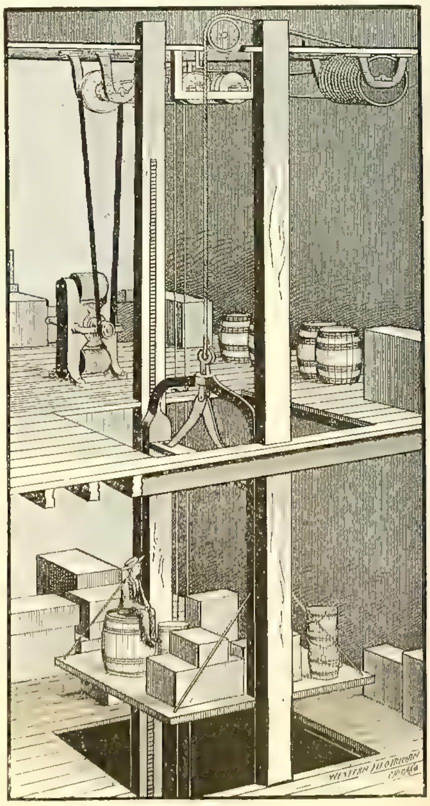
HAWKEYE ELECTRIC MOTORS IN FLOUR MILL.



[illegible]

Hawkeye Electric Motors.

The accompanying cuts illustrate the Hawkeye electric motor in operation. These machines are manufactured by the Hawkeye Electric Manufacturing company of Davenport, Ia. The shops were recently removed to that point from Oskaloosa. The company is now controlled by Davenport capitalists, who have purchased the interest of the Oskaloosa stockholders. The men composing the new company at Davenport are widely known as substantial business men. They include James Thomson, F. H. Griggs, Louis P. Best, Nicholas Kuhnen, M. L. Marks, Jas. P. Donahue, George W. Cable, E. P. Lynch, William L. Allen, Walter Chambers, H. H. Andresen, Jens Lorensen, J. S. Wylie, A. Burdick. The company is now located in its new shops at Davenport, the capacity of which is greatly

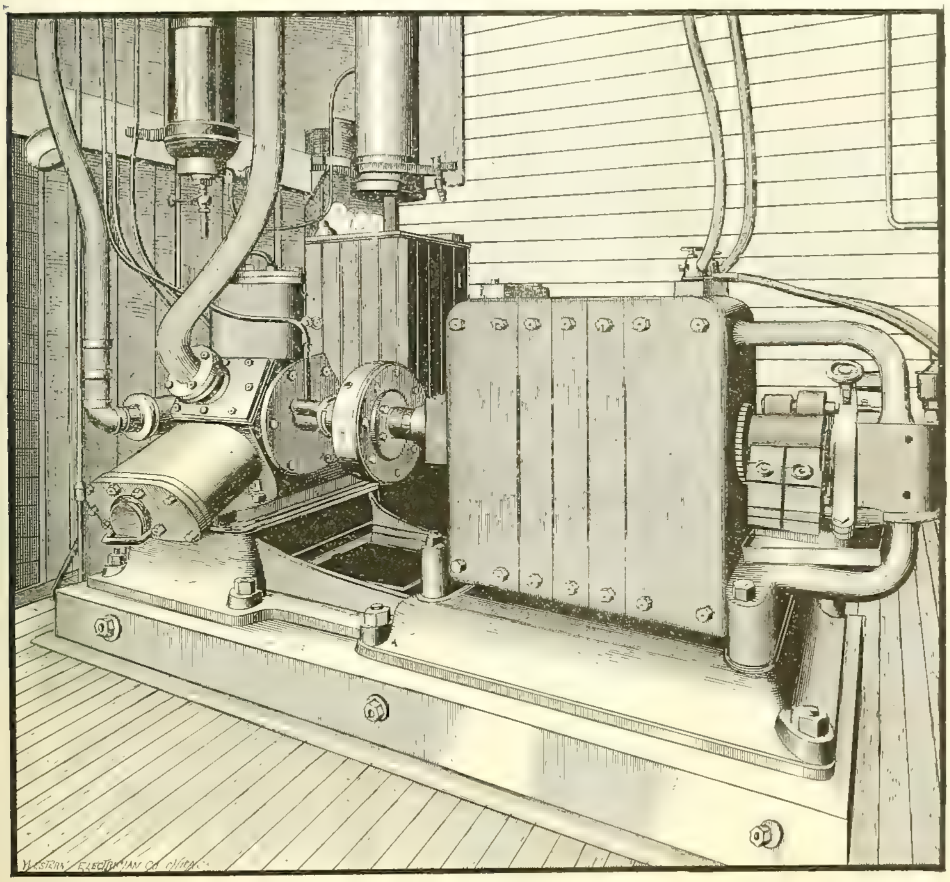


HAWKEYE ELECTRIC MOTORS ON ELEVATOR WORK.

increased. A specialty is made of mechanical motors, guaranteed to be automatic, first-class workmanship, and the highest efficiency. The motors, as the illustrations show, are made in several types and styles, as occasion may require, or the peculiarities of the work demand. In connection with the manufacture of mechanical motors, considerable attention will be given to water powers and their utilization and distribution; the establishment of power in cities and the introduction of day circuits in connection with electric lighting companies, and distributing power therefrom by means of mechanical motors.

Electric Train Lighting.

The accompanying cut represents a dynamo of the Eickemeyer type and a Brotherhood engine in position in the baggage car of a Chicago, Milwaukee & St. Paul train lighted by electricity. The installation was made by Leonard & Izard of Chicago, and is an excellent piece of work. Train lighting by electricity has passed the experimental stage, and is now a necessity on



ELECTRIC LIGHTING ON THE CHICAGO, MILWAUKEE & ST. PAUL RAILROAD.

first-class roads. It was not, however, until much time and attention had been given this subject that it was brought to its present state. Many devices were tested, only to be found wanting. The placing of a dynamo in the baggage car, and driving it by belt from the revolving car axle, was among the early suggestions, but its application was impracticable, since current would be furnished only when the train was in motion. It became apparent that the storage battery would meet this difficulty, and trials were made with this combination, the batteries also being located in the baggage car. It was found, however, that even this arrangement would not suit the purpose, since the batteries occupied too much space in the cars. This objection was overcome by placing a set of cells under the floor of each car in receptacles between the wheel trucks. The axle gearing has been superseded by a small Brotherhood steam engine, located in the baggage car, deriving its steam from the locomotive through a flexible pipe. The entire plant occupies a comparatively small space, and is exceedingly compact. The engine is run as long as necessary for charging, and the light is available at any time during day, as well as for regular night use. The train may be broken up at will, in running it upon a ferry boat, in arranging the cars at the depot, or otherwise, without affecting the light. By means of flexible cables and couplings the batteries of the several cars are speedily connected to the dynamo for charging, even while the train is running. The advantages of the electric light for car lighting, its brilliancy, steadiness and safety, make it the ideal light for the purpose, a fact which is fully appreciated by those who have occasion to travel in cars thus equipped. The plant under consideration has been operated since January 15th, and has proved satisfactory in every respect. It contains all the modern devices, and is considered by the railroad company an ideal installation. J. H. Bunnell & Co. of New York city are sole agents for the Eickemeyer dynamo.

Chicago Electric Club.

At the meeting of the Chicago Electric club February 4th arrangements were made for the entertainment of visitors in attendance at the National Electric Light association convention at Chicago, February 19-21. The rooms of the association will be opened to the visitors and ample entertainment furnished. The headquarters of the club will be lighted by electricity on the occasion. The Edison company will furnish the current, the Electrical Supply company, the Knapp Electrical works, the Thomson-Houston company and the United States company will furnish lamps, wire, etc. A vote of thanks was tendered each of these companies for their generous contributions.

After the regular business meeting an animated discussion ensued on the paper read by Alexander Thompson on "Thickness of Insulation," which was published in last week's issue. Mr. Badt was the first speaker. He said:

I think perhaps the thickness of dielectrics for the different cases as suggested is fair, and I believe it is about what I proposed in combination with the formula to be applied for insulation resistances. I think it was in that connection that I asked Mr. Thompson to prepare this paper. If we could afford to spend the money necessary for such an excellent insulation as is proposed, it would be well to do so. However, I think that in combination with our formula which we will finally adopt we can determine the thickness of the insulation, and I think it would be proper when we have determined upon our formula to vote on this question of the thickness of the dielectric in the different cases.

MR. THOMPSON: Mr. Chairman, I want it understood that the length of spark that I have worked out with each electromotive force gives the maximum strain that can be brought upon any one point in the cable, and that is where that six inches comes from. Suppose with 10,000 volts you suddenly break the circuit right over the connecting wire of your dynamo, over to the discharge of the insulating positive wire, the strain at that instant is such that it would tear any insulation that you would put upon the

[illegible] with [illegible]

[illegible] cotton which had passed through some black substance. [illegible] volts, all night during a rainstorm. Now, that [illegible] connected direct to the working wire lying upon the in[illegible] difference between [illegible]

MR. [illegible]: I [illegible] currents of less alternating force [illegible] Of course, in a formula [illegible] value of A. It is not altogether in the thickness of the dielectric, but also the electro-static capacity of the insulation. [illegible] the length of the spark.

MR. SPERRY: I understand there is an alternating current installation of 10,000 volts [illegible]. From what I understand by your remarks the alternating current should have at least three times the [illegible] of the direct current of the same voltage.

MR. THOMPSON: That is to say, with the disruptive effort. One way of illustrating that is to [illegible] a weight and tie a string to it. Pull on the string and then suddenly reverse the strain. It sets up what is called in gunnery these vibratory motions. The only question is whether that is the same in electrical pressure as in others.

MR. SPERRY: The point I wish to bring out is this. In one of the formulæ giving the spark length, for instance, through air, the law seems to hold above a certain point, below which it will not hold. Why could not the converse of that law perhaps be governed by a formula like this?

MR. THOMPSON: That was the point I made; that result was surprising for that voltage. The law may change. The only way to determine it would be to work out the thickness of dielectric, work out the curve and after you get your curve then get an equation. In a great many cases you will find, after you have worked out a curve, that one equation fits one part of it, but you have to have another for another part of it. Of course these figures are only based on those results. You take a thousand volts alternating and it does not give a very high thickness. In an alternating machine, with a sudden break in the current, you can imagine a case in which the strain is brought very suddenly upon it. Say, for example, that the current is shut off very suddenly, and then thrown right on again. That has the effect to bring four times the strain upon it. I think in a great many cases this has been the cause of disrupted insulation. That is, that the strain has been applied so suddenly that it could not stand it. Whereas, if it was brought on in ordinary practice there would be no break at all. You may take a modern gun and use powder in it that rises simply to a high pressure; but take the same powder and grind it up finer so that it flashes all at once, and the pressure would be sufficient to burst it.

MR. SPERRY: This piece of wire that I speak of, it was said, if lying across the same difference of potential during that night of the storm it would probably have gone through, and the reason given was that probably an alternating action would have been set up, which would have driven it through. Now the extra current comes into play, the direct current, and if the circuit is parted, slowly or quickly, there is a larger flash than there is with the alternating current of the same force. With the alternating current you cannot break it slow enough to give a tremendous flash. But if you break it with any degree of instantaneous action the flash is almost imperceptible. If that same current was broken with even an apparently low potential direct, the spark attending it would be very great, indicating that the difference of potential was very great. I do not think that the statement made is capable of the broad interpretation that might be given it—that the alternating current is more liable to break through than the direct.

MR. THOMPSON: I think, Mr. Sperry, there may be something in that, but at the same time I believe that where the alternating current insulation should be broken down, the other factor that I spoke of comes in. I know that they cease operating the cables on the east and west coast of South America as long as possible every night, in order that they may resume their normal condition, that this frequent reversal changes the dielectric in some way. This explanation was given to me concerning the alternations of those systems of cables. In some way the electro-static capacity of the cable was increased, so much that after it had been in constant use ten or twelve hours, the operators had to switch in additional batteries [illegible] on account of the increasing capacity of the cable as a condenser, and the same increase occurs with [illegible] alternations, in the alternating current machines. These alternations in the ordinary machines are [illegible] to the minute. You can judge how nearly instantaneous that is, comparing it with other shocks. In the alternating current, the greater number of alternations per minute, the greater the strain on the dielectric. If a certain [illegible] of alternations are not exceeded, the insulation will stand the pressure all right.

MR. SPERRY: Of course in the ordinary alternating current system, the length of the alternations is supposed to be [illegible] of a second, or [illegible] a minute. We know that the disrupted discharge takes place in [illegible].

... parison at all in the ... consideration, especially

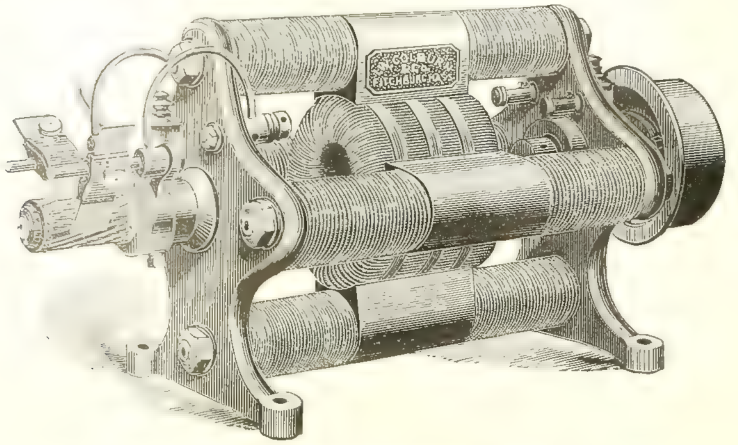


FIG. 1.—COLBURN SERIES INCANDESCENT DYNAMO.

in the matter that you have just brought to my notice, of course the cable of the alternating system should wear out immediately. On the ordinary trans-Atlantic cable it is worked very slowly. The impulses go back and forth, following the swing of the needle almost, and of course those alternations are extremely slow as compared with the alternations in the alternating current system. If the time is taken into consideration the instantaneous application of this stress on the insulation opens up a whole field that has got to be experimented with.

MR. THOMPSON: The stress comes, of course, at the point of reversal.

MR. SCHEFF: What would be the shape of your curve if you increase the alternation? A perpendicular line; time is the only element you are talking about.

Mr. Thomson and Prof. Badt engaged in a discussion on the construction of guns and the application to electric wires of the laws governing the ability of these guns to stand high pressure. At the conclusion of the debate a vote of thanks was tendered Mr. Thompson, and the meeting adjourned until February 11th, when a special meeting was held.

Colburn Electric Light System.

G. A. Harmount, western agent for the New Haven Clock company, Chicago, is introducing to western purchasers the Colburn system of electric lighting, which is herewith illustrated. This system is admirably adapted to ship lighting, it is claimed, and is also desirable for lighthouses. Fig. 6 illustrates an arc light dynamo. The armature is of the Gramme type, and is free from vibrations and sparking. Fig. 2 represents an incandescent light dynamo of extremely high efficiency. There is an absence of sparking and the machine is self-regulating, owing to the system of winding. It is claimed for this mode of construction that it gives all the advantages without ... The ... ted and ventilated armature, good workmanship and perfect mechanical and electrical design, all tend to add to the perfectly satisfactory working of the dynamo. Fig. 3 represents a light dynamo that may be driven by a gas, kerosene, or small steam engine, or water motor. They are in their workings similar to the large incandescent machines, having most of the improvements that are introduced on the latter. The series incandescent dynamo illustrated in Fig. 1 is made in sizes to supply from 25 to 300 sixteen candle power lights. It finds a field in illuminating towns that are sparsely populated and extend over a large territory, where the multiple arc system is not practical on account of the expense of wire. With it are used lamps from ten to as great a candle power as may be desired. This system finds its field also in street lighting, being especially adapted for that use. The lamps are connected the same as arc light circuits in series, but one wire being used. With each lamp is an automatic cut-out that is positive in its action, and when a lamp fails for any reason, it immediately cuts the defective lamp from the circuit without disturbing the remaining lamps in circuit.

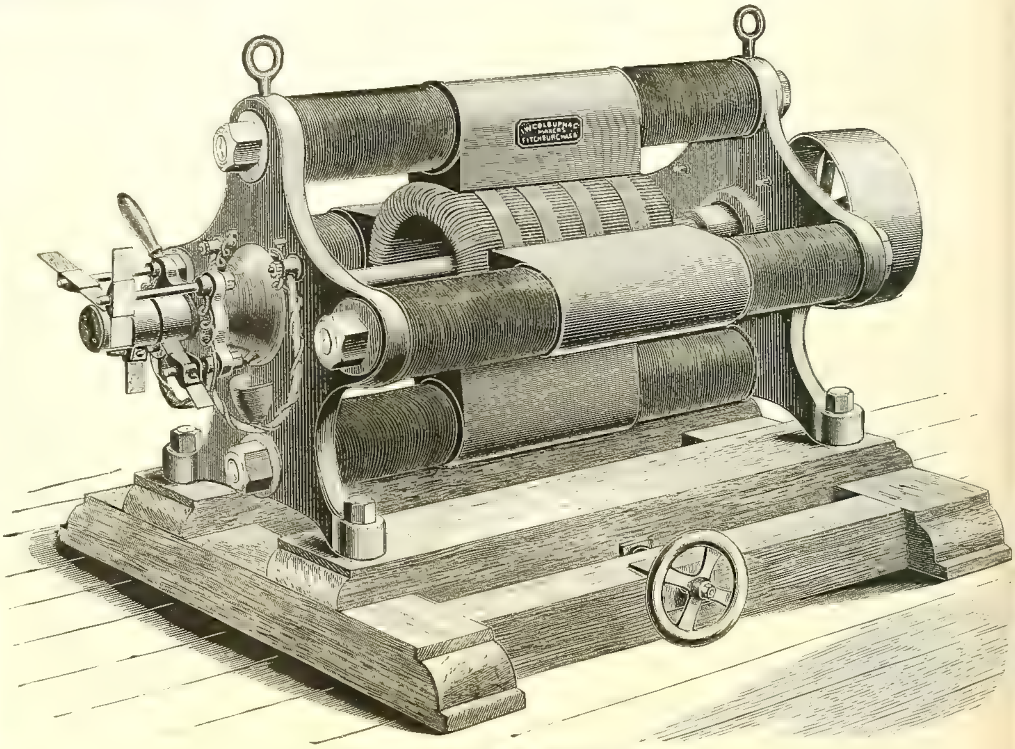


FIG. 2.—COLBURN INCANDESCENT DYNAMO.

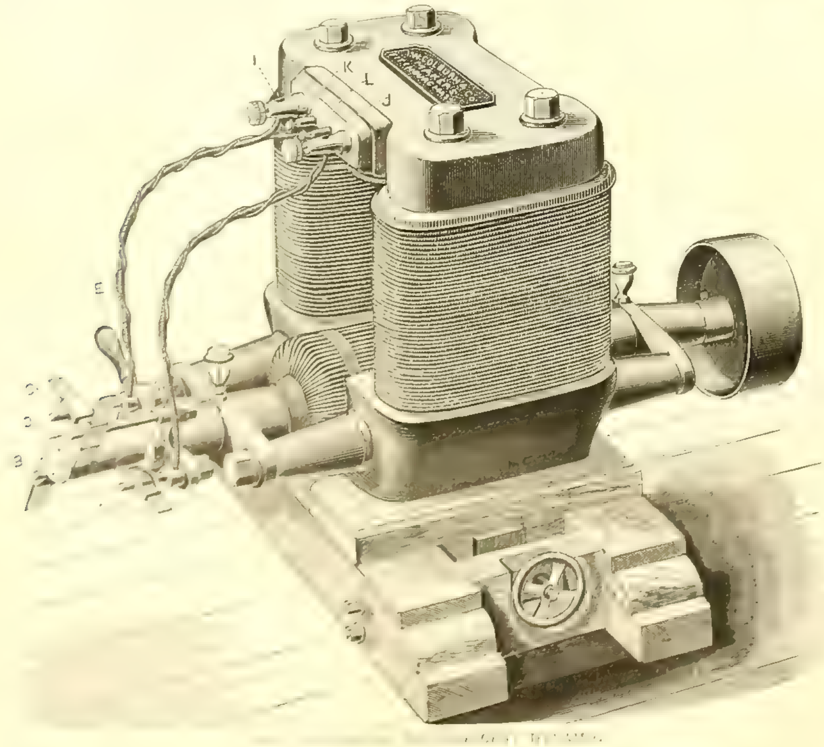


FIG. 3.—[illegible]

The arc lamp of this system is of graceful design, and constructed with the view of casting as few shadows as possible. It consists of an iron framework, with a clamp for holding the negative carbon at the bottom; also screws and base-plate for clamping and holding the glass globe. The surmounting framework is an iron case containing the regulating mechanism, which is simple, durable and reliable. The arc is regulated and maintained by the current itself so long as it continues to flow. Each lamp has an automatic switch and cut-out, which, in case trouble exists, or when carbons are consumed so much as to endanger the carbon-holders, will immediately cut itself out of the circuit. Besides the plain lamp there is also an ornamental lamp. It is claimed, in behalf of the incandescent lamps herewith illustrated, that they are durable, economical of current, and do not discolor. It is also asserted that they give the ratio candle power until worn out. Two styles of incandescent lamps are illustrated, showing one with a switch and another without.

Tests of the Detroit Storage Battery at the Johns Hopkins University.

BY DR. LOUIS DUNCAN AND G. A. LIEBIG, JR.

ELECTRIC TESTING BUREAU, JOHNS HOPKINS UNIVERSITY,
BALTIMORE, Md., Feb. 1, 1889.

There were sent to the Electric Testing Bureau of this University three types of cells as made by the Woodward Electric company for the purpose of having such experiments conducted as would lead to the determination of the following quantities: First, capacity; second, internal resistance; third, durability; fourth, efficiency; the latter, as far as possible, in widely different conditions of charge and discharge. The three forms of cells were distinguished by the marks 25 M, 15 M, 11 P, respectively. The method

pursued in the manufacture of these cells seems to [illegible] follows. A block of appropriate size, consisting of a mixture of salt and lead, is cut into plates of the desired thickness, about 3-16 or 1/4 inch. The plates are then immersed in water which dissolves out the salt, leaving the plate of lead with numerous pores of irregular shape throughout the entire mass. After this the pores are filled with a paste of oxide of lead in the ordinary way, following which is the process of "forming," and the plates are then ready for use.

I. *Capacity.*—Type 25 M.

These cells are of twenty three plates, eleven positive and

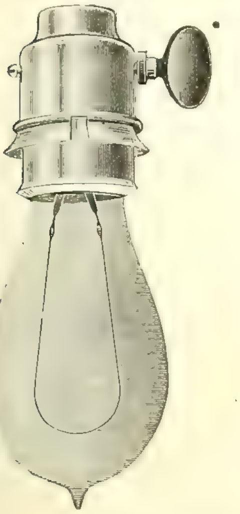


FIG. 4.

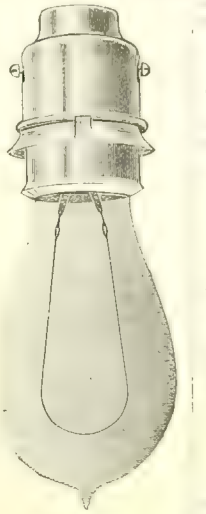


FIG. 5.

COLBURN INCANDESCENT LAMPS.

twelve negative. The weight of the plates as joined up in the cell with lead connections was 84 lbs.

December 20th to 28th. Charge (see table 1)—Mean current 16 amperes, mean e. m. f. 2.35 volts, total charge 420 ampere hours. Discharge (see table 1)—Mean current 17.5 amperes, mean e. m. f. 1.9 volts, capacity 400 ampere hours, efficiency 78 per cent.

January 8th to 14th. Charge—Mean current 23.5 amperes; mean e. m. f. 2.27 volts, total charge, 453.6 ampere hours. Discharge—Mean current 18 amperes, mean e. m. f. [illegible] volts, capacity 378.2 ampere hours, efficiency 75 per cent.

January 17th to 22nd. Charge (see table 2)—Mean current 27 amperes, mean e. m. f. 2.25 volts, total charge 431.6 ampere hours. Discharge (see table 2)—Mean current 60 amperes, mean e. m. f. 1.75 volts, capacity 352.4 ampere hours, efficiency 64 per cent.

Type 15 M.

The first charge of this cell was carried very much beyond the necessary limit, in order to reduce a considerable amount of sulphate which was found on the plate; weight 67 lbs. 6 ozs.

December 4th to 8th. Charge—Mean current 20 amperes, total charge 390 ampere hours. Discharge—Mean current 19.5 amperes, mean e. m. f. 2.5 volts, capacity 170 ampere hours, efficiency 65 per cent.

December 26th to 28th. Charge (see table 3)—Mean current 18 amperes, mean e. m. f. 2.35 volts, total 255 ampere hours. Discharge—Mean current 10 amperes, mean e. m. f. 2.8, capacity 207.5 ampere hours, efficiency 76 per cent.

January 2nd to 7th. Charge—Mean current 13 amperes, mean e. m. f. 2.33 volts, total 279 ampere hours. Discharge—Mean current [illegible] amperes, mean e. m. f. [illegible] volts, capacity [illegible] ampere hours.

January [illegible] to 14th. Charge (see table 4)—Mean current [illegible] amperes, mean e. m. f. 2.35 volts, total charge [illegible] ampere hours. Discharge (see table 4)—Mean current [illegible] amperes, mean e. m. f. 2.0, capacity 210 ampere hours, efficiency [illegible] per cent.

January 21st. Charge—Mean current 27 amperes, mean e. m. f. [illegible] volts, total charge 250.2 ampere hours. Discharge—short circuit, mean current 250 amperes, capacity [illegible] ampere hours. The cell was charged and discharged at very high rates, charging rate [illegible] amperes, discharge rates 250 amperes. [illegible] repeated.

Type 11 P.

Weight of plates and connections 23 lbs. 7 ozs.

December 12th to 17th. Charge (see table 5)—Mean current 84 amperes, mean e. m. f. 2.21 volts, total charge 112.0 ampere hours. Discharge (see table 5)—Mean current 76 amperes, mean e. m. f. 1.97 volts, capacity [illegible] ampere hours, efficiency 75 per cent.

II. *Internal Resistance.* Type 25 M.—For mean current, .0036 ohm.

Type 15 M.—For mean current, .0064 ohm.

Type 11 P.—For mean current, .0056 ohm.

III. *Durability.*

As far as can be seen the cells are in an excellent condition, and no signs of deterioration are as yet evident. The cell 17 M, whose normal discharge rate is 20-25 amperes, was short circuited a number of times through about [illegible] feet of No. 8 copper wire, its resistance being about .0028 ohm. The discharge rate in the cell was very high, being more than 250 amperes, the cell, however, seems to have suffered nothing by the treatment. The plates have not "buckled," nor have we found parts of the active material forced out from the pores.

IV. *Efficiency.*

The values of the efficiency vary with the rate of charge and discharge. For the normal rates of discharge the efficiency of the different type of cell examined is between 75 and 80 per cent. In some cases the values are low; this is due to the cell having been previously run down below the ordinary limit.

TABLE 1.—CELL 25 M.

Charge—Time	Current.	E. M. F.	Amp. Hours.
2.45 A. M.	16	2	
5 P. M.	16	2.1	36
8.45 A. M.	16	2.2	
5 P. M.	16	2.4	132
8 A. M.	16	2.4	
5 P. M.	16	2.45	144
8.30 A. M.	15	2.5	
2.30 P. M.	15	2.5	107—420
Discharge			
4 P. M.	19	2.1	
10 A. M.	19	2	342
10.50 A. M.	17	1.95	35
12.50 P. M.	17	1.85	
2.15 P. M.	12	1.7	29—400
Discharging all night.			

TABLE 2.—CELL 25 M.

Charge—Time	Current.	E. M. F.	Amp. Hours.
12.15 P. M.	28	2	
2.45 P. M.	23	2.1	
4 P. M.	22	2.1	66.6
10.15 A. M.	30	2.15	
12 M.	28	2.22	
5 P. M.	28	2.25	150
11 A. M.	33	2.35	
2 P. M.	27.5	2.5	
5 P. M.	27.5	2.5	
5 P. M.	27.5	2.6	172.2—431.6
Discharge			
10.40 A. M.	56	1.97	
3 P. M.	54	1.85	

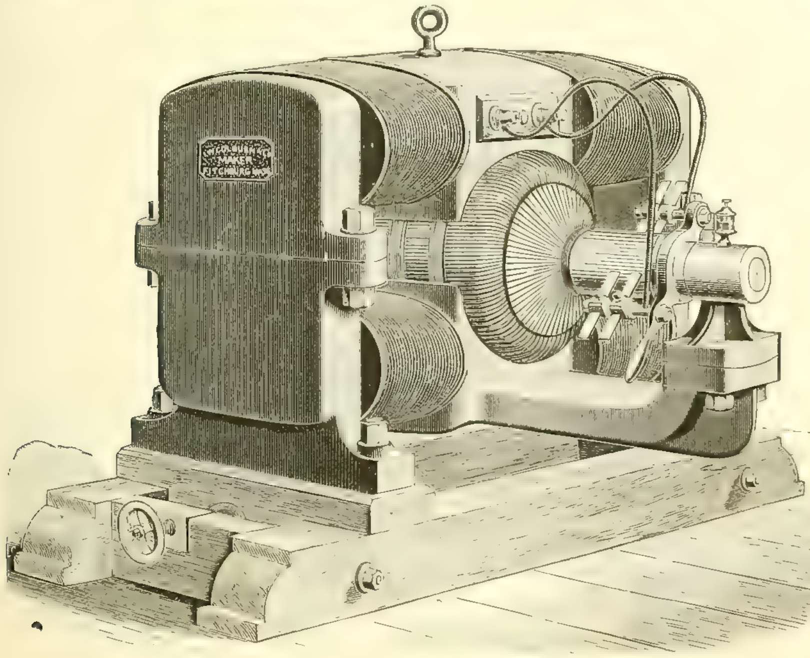


FIG. 6. COLBURN ARC LIGHT DYNAMO.

Charge—Time	Current.	E. M. F.	Amp. Hours.
[illegible]	[illegible]	[illegible]	[illegible]
[illegible] M.	[illegible]	2.1	[illegible]
[illegible] M.	[illegible]	[illegible]	[illegible]
Discharge			
[illegible]	[illegible]	[illegible]	[illegible]

TABLE 4.—CELL 15 M.

Charge—Time	Current.	E. M. F.	Amp. Hours.
10.4[illegible]	[illegible]	[illegible]	
[illegible]	1[illegible]	2.1	
[illegible]	[illegible]	2.2	
10 [illegible]	[illegible]	2.2	
[illegible]	1[illegible]	2.4	[illegible]
11 [illegible]	[illegible]	2.4	
4 [illegible]	1[illegible]	[illegible]	[illegible]
Discharge			
[illegible]	1[illegible]	2.2	
2 [illegible]	1[illegible]	2	
4.20 [illegible]	1[illegible]	2	[illegible]
[illegible]	1[illegible]	[illegible]	
1[illegible]	14	2	
4 [illegible]	1[illegible]	[illegible]	[illegible]2
[illegible]	14	2[illegible]	
10 [illegible]	[illegible]	1	1[illegible]—210

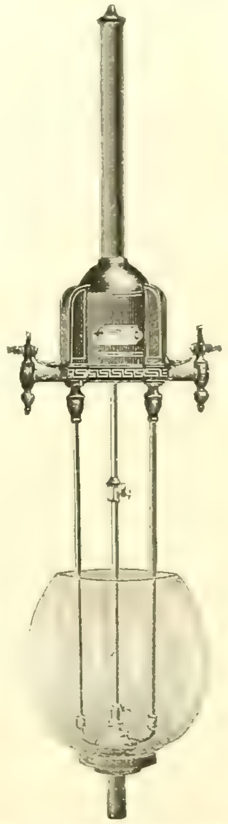


FIG. 7. COLBURN A[illegible]

TABLE 5.—CELL 11 P.

Charge—Time	Current.	E. M. F.	Amp. Hours.
9 A. M.	10	2.1	
5 P. M.	[illegible]	2.25	[illegible]
9 A. M.	[illegible]	2.3[illegible]	
12 M.	[illegible]	2.[illegible]	28[illegible]
12.40 P. M.	[illegible]	2.[illegible]	[illegible] 112.0
Discharge			
11 A. M.	[illegible]	2.0[illegible]	
2 P. M.	[illegible]	1.9[illegible]	
4.20 P. M.	[illegible]	1.8[illegible]	[illegible]
10.20 A. M.	10	2.0[illegible]	
2.10 P. M.	9	1.[illegible]	
3.20 A. M.	7.3	1.[illegible]	11[illegible]

Fourteen or fifteen years ago the electric light was practically unknown so far as the [illegible] was concerned, and at that time the electrical staff at [illegible] was principally engaged on minor repairs to the apparatus for firing guns and to electric bells. So great has been the progress, that at present the electrician at Portsmouth dockyard has 54 workmen on the books of his department, besides apprentices. The electric shop has been enlarged several times, and is about 240 feet long [illegible]. An important electrical question now under consideration is that of lighting the dockyard. Hitherto when it has been found necessary to keep the dockyard [illegible] night electric installations have been temporarily [illegible], but it is now considered [illegible] yard by electricity.

Electro-Plating Outfit.

The electro-plating outfits illustrated herewith [illegible] of machinery [illegible] Co. of Newark, N. J. [illegible] which is used [illegible] represents the use of [illegible] 36 inches long, [illegible] deep inside, and [illegible] The bat

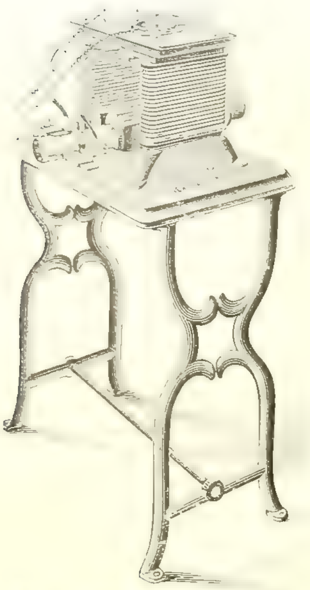


FIG. 2. ELECTRO-PLATING OUTFIT.

teries are particularly adapted for nickel plating. The outfit, with the exception of the batteries, is available at any time where batteries are displaced by an electric machine.

The "Little Wonder," represented in Fig. 2, is the latest improved form of this style of machinery. It is only one-tenth as large as the first machine, Fig. 3, manufactured by Woolrych in 1848, but it is capable of ten times as much work in the same time, and of course is superior in all respects to the original invention.

Insulation Resistance of Electric Light Installations.

BY [illegible] A. [illegible]

[illegible] has formed the topic of [illegible] for some time, is [illegible] parts of the world. In this [illegible] read before the Institution

which would enable their lines to be worked with success. Not only are careful insulation tests now made during the manufacture of insulators and the erection of the land lines under the British Postal Telegraph Department, but "daily tests" are taken of all the more important lines. The minimum insulation resistance which each insulator should have depends upon the length of the line. For a line of 100 miles each insulator is expected to give a resistance of 500 megohms, whereas, for a line of only ten miles, fifty megohms is considered sufficient. When a line has been erected and put into working order it is usual to fix upon a minimum standard insulation resistance per mile. If the measured value at any time falls below this standard then the line is considered faulty, and steps are taken to remove the fault. The postoffice standard is 200,000 ohms per mile. In the cases of subterranean lines and of submarine cables an even still more rigid and careful system of inspection and of testing is now carried out during the manufacture of the cores and cables. The results are invariably reduced to an insulation resistance per unit of length at a standard temperature. The following extract from the specification of a successfully made and laid cable will serve to illustrate this: "The insulation resistance per knot of the gutta percha core shall not be less, when tested at 75° F., than 300 megohms fourteen days after manufacture and after two minutes' electrification. If the resistance of any portion of the gutta percha (reduced to 75° F.) at any period of the manufacture falls below the above specified limit, the cable is to be rejected." Throughout the whole of the operation of coiling and uncoiling a cable into the shore and ship's tanks, during the laying, and subsequently during its existence, the insulation resistance is periodically measured and tabulated.

[illegible] Insulation Resistance in Electric *Lighting.*—We have been induced thus to particularize the extreme care and attention which is now considered absolutely necessary in the case of land lines and of submarine cables, because the industry of electric lighting has just passed through a similar experience to that which these industries met with in their earlier days. When the industry of electric lighting was first beginning to take root in this country electric light engineers pooh-poohed the idea of accurately measuring the insulation resistance of any part of their work, and they invariably turned a deaf ear to the timely warnings of telegraph engineers and electricians.

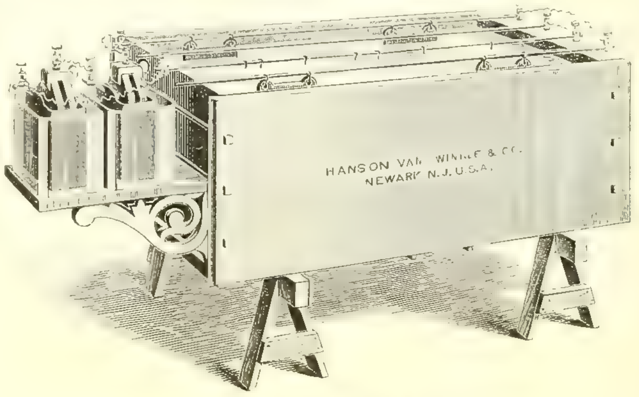
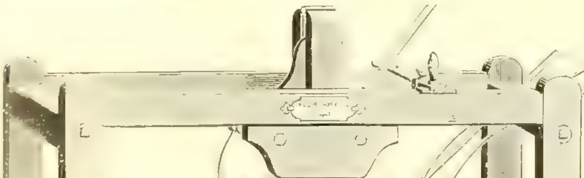


FIG. 1. ELECTRO-PLATING OUTFIT.



[illegible] January 24th

[illegible] as it did their elect[illegible] through [illegible] importance, and that it [illegible] attention to details and [illegible] conductors and elec[illegible] not [illegible] take place, [illegible] electro-chemi[illegible] present and [illegible] short circuit or [illegible] lighting. Dis-

credit thus not only falls upon the contractor, but others are frightened from employing the electric light.

[illegible] a Standard of Insulation Resistance.—The terms usually employed in regard to the insulation resistance of an electric light installation are that it shall be "good" or "perfect," according to the fancy of the party purchasing the plant or of his adviser. These terms have, however, no specific meaning, and are therefore variously interpreted. No doubt the society has had this subject before them in committee when drawing up their set of rules for the "prevention of fire risks;" but the institution as a whole has never had an opportunity of discussing it, and thereby of impressing its members and the public generally with its importance, and the necessity for observing some minimum standard of insulation resistance. The writer had his attention directed the other day to a communication read before the International Society of Electricians, Paris, in November last, by M. Picou, wherein that gentlemen ably analyzed this question, and proposed a rule based upon tests of short lengths of cotton-covered insulated wire. He has not had an opportunity, however, of learning the extent and the nature of the discussion upon M. Picou's paper, and he can only, therefore, place his rule before the members, along with a few other rules, and leave them to form their own opinions, guided by their practical experience.

General Propositions.—The following points will no doubt be readily admitted in regard to insulation resistance of electric lighting installations:

1. That, owing to the comparatively low resistance of the conductor circuit of ordinary electric light installations on the parallel incandescent system, the minimum standard of insulation resistance does not require to be nearly so high per unit of length as in the case of submarine cables.

2. That it should be directly proportional to the electromotive force of the generator, or difference of potential between the conductor and earth, or between the forward and return conductors.

3. That it should be inversely proportional to the total length of the insulated conductor, or to the total current, or to the number of lamps in circuit.

4. That, whatever rules or standards of insulation resistance may be adopted, they should be applied, not only to all the conducting wires, but also to the dynamo, the lamps, and all the fittings, or, in other words, to the whole circuit.

Rules.—1882 Set of Rules by Society of Telegraph Engineers and Electricians.—In May, 1882, in the first set of "Rules and Regulations for the Prevention of Fire Risks Arising from Electric Lighting," issued by the Society of Telegraph Engineers, no standard of insulation resistance or of minimum leakage is recommended. All that we find there on this head is: "The difficulties that beset the electrical engineer are chiefly internal and invisible, and they can only be effectually guarded against by testing or probing with electric currents;" "All wires used for indoor purposes should be efficiently insulated," etc.; "The insulation of dynamo coils and conductors should be practically perfect;" "The value of frequently testing the apparatus and circuits cannot be too strongly urged," etc.

Five years ago even the writer is not aware that any published rule existed, or that any specification contained any definite rule for the insulation resistance of any part of any electrical installation.

Admiralty Rule.—About 1883 or 1884, however, the Admiralty officials requested that the insulation resistance of the dynamos supplied to them should withstand the test of stroking the free end of a conducting wire, the other end being connected to either pole, over any part of the framing without showing any signs of sparking when the machine was driven at its normal speed. The writer does not know whether they still insert this clause in their specifications or whether they have modified or improved it, but at best it is only a rough and ready test, and gives no indication whatever as to the precise locality of a fault or its value in ohms.

[illegible] Test.—The only test applied by contractors when wiring an installation was, and often still is, that of simply inserting an ordinary lineman's detector or galvanometer, G, between a battery, B, of one or two cells, and the leads, with the other end or ends freed, as in Fig. 1. If the galvanometer gives no deflection, or a very small one, then the section is passed as all right.

This is such an exceedingly simple and handy test for workmen that it can scarcely be improved upon, but it gives no precise indication whatever of the resistance in ohms, or the defective part of the fittings. It simply informs the [illegible] whether there is a bad fault or not. He can also find out by it whether the continuity of the conductor is complete, by earthing the further end, and he can also ascertain whether there is a short circuit or not between any

two or more "forward" and "return" leads by connecting up his apparatus as shown in Fig. 2.

In 1884 William Denny & Brothers' electrician [illegible] a small portable magneto-electric machine and [illegible] —the same as telephone companies employ— instead of the above mentioned galvanometer and battery. If [illegible] rang a fault existed, and its position had to be [illegible]; if it did not then all was supposed to be right. He, however, in addition to this merely workman's test, applied a more exact test by Wheatstone bridge, and thus obtained the insulation resistance of the whole or of any [illegible] portion of the circuit and the fitting in ohms.

Prof. Jamieson's Rule.—In 1884, while testing the electric light wires and fittings of some ships, the writer first drew up this rule, which has been published in the last three editions of Munro and Jamieson's "Pocket Book of Electrical Rules and Tables." He had previously [illegible]

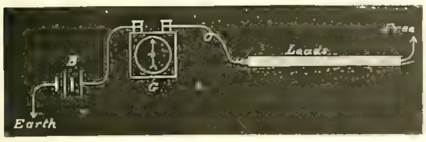


FIG. 1.

[illegible] tested, by Wheatstone bridge, etc., the insulation resistance of a number of land and ship installations and was rather surprised at the variety and lowness of the dielectric resistance, for his ideas of insulation resistance had been somewhat magnified by seven years' experience with submarine cables. At first he could not get contractors to come up to his rule, but he was much gratified about this time by the enthusiasm and interest which William Denny & Brothers' electrician took in the matter and by finding such good results in his tests of their ships' lighting leads, which results so far surpassed the demands of his rule that he decided to adhere to it. Since then he has had much less difficulty, and when care and attention to cleanliness in jointing, to the fixing of wires and fittings, as well as in the manufacture of dynamos, are observed, he has frequently found that the insulation exceeded the demands of his rule, which is as follows: "A careful insulation resistance test of each circuit, and finally of the whole of the circuits (including all switches and terminals, but not necessarily the lamps) joined up together, should be taken by the method described above, and not passed unless the resistance is at least equal to 1 Ω per lamp for every volt employed. The insulation resistance of the dynamo coils should be equally good." Put into formula shape the rule is:

$$R_1 = k\frac{E}{N_1}.$$

where R_1 = the total insulation resistance of the whole or any part of the lamp circuits, or of the generator in ohms;

K = a constant (.1 Ω = $\frac{1}{10}$ Ω = 100,000 Ω) found from actual tests of several well erected installations;

E = e. m. f. of dynamo or installation in volts;

N_1 ½ = number of lamps (16-candle power) on each circuit or on the whole circuit.

The insulation resistance is therefore here taken to be directly proportional to the normal e. m. f. of the dynamo and inversely proportional to the number of 16-candle power lamps in circuit. The difficulty of ascertaining the precise length of the mains, sub-mains, leads and dynamo windings led the writer to substitute the number of lamps in circuit for what might at first sight appear to be the more exact term in the denominator, viz., the length of conducting wires employed. Although not stated in the above quotation of his rule, the writer usually applies the same test for the resistance or percentage leakage of current

FIG. 2.

rent between the whole system of forward and return wires, also between the dynamo armature with field-magnet coils in circuit and the frame or body of the machine, as well as between the series and shunt-magnet coils if the dynamo is of the compound or series-shunt type. The following example and table will make the application of this rule clearer:

Suppose that we have an installation of 100 lamps of 16-candle power each, and that the normal difference of potential between the terminals of the dynamo is 100 volts; then the insulation resistance should not be less than

$$R_1 = k\frac{E}{N}.$$

$$= 100{,}000\ \omega\ \frac{100\ v}{100\ l}$$

$$= 100{,}000\ \omega = .1\ Ω.$$

The leakage allowed by this rule in the case of 100 volt lamps using .64 ampere of current per lamp is

$$C = \frac{E}{R} = \frac{100\ v}{10{,}000{,}000\ \omega} = \frac{1}{100{,}000}\ \text{ampere of leakage}$$

for every lamp in circuit. Each lamp, however, requires .64 ampere; consequently the leakage = $\frac{1}{64000}$th part of the total current, or the percentage leakage = $\frac{1}{640}$ = .0016 per cent. Since by the above rule the dynamo requires to have the same insulation resistance as the lamp circuit, the insulation resistance of the whole circuit, including the dynamo, is half of that given by the formula and tables, and therefore the leakage is double, or $\frac{1}{32000}$th part of the total current, or $\frac{1}{320}$ per cent. = .0032 per cent.

[illegible] Insulation Resistance [illegible] Rule [illegible] Lamp Circuits and Dynamos.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]—In May 1888 [illegible] the Phœnix Fire Office [illegible] Mr. Heaphy [illegible] "In any electric light installation [illegible] no matter how wet the weather may be. For alternating currents the minimum insulation resistance should be twice the above number of ohms, respectively."

In November 1888, in the fourteenth edition, Mr. Heaphy is more precise, and he has added a table based upon similar proportions to the writer's rule. His rule No. 27 reads as follows:

"In any electric light installation in which the current is continuous, and has an electromotive force of 200 volts or under, the insulation resistance over the whole installation should not be below the following:

Installations of	25 lights,	500,000 ohms
"	50 "	250,000 "
"	100 "	125,000 "
"	500 "	25,000 "
"	1,000 "	12,500 "

"When lights are proportionate between the above numbers then the insulation resistance should be correspondingly proportionate. The insulation resistance of separate circuits of the installation should also be taken, and should be in accordance with the above table. For alternate currents the minimum insulation resistance should be twice the above number of ohms, respectively."

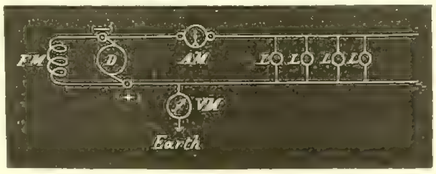


FIG. 3.

Objections to Phœnix Rule.—The following objections may be offered in regard to this last rule:

1. It ties down a contractor to one and the same insulation resistance, whether the e. m. f. of the installation lies anywhere below 200 volts. Surely a 50-volt installation requires but half the insulation resistance of a 100-volt one, and but one-fourth that of one with 200 volts.

2. It is somewhat doubtful (owing to a previous note to Rule No. 20) whether the words "over the whole installation" include the dynamo as well as all the wires, fittings and lamps.

3. No distinction is made between circuits with one, or two, or more lamps in each parallel.

4. Arc lamps of 2,000 candle power or more in parallel and large incandescent lamps of 500 candle power or more, which require strong currents, come under the same general words, "any electric light installation in which the current is continuous," just as much as small incandescent lamps of, say, 5-candle power, which require only a fraction of an ampere.

A question naturally arises here for discussion—should not the insulation resistance in such extreme cases bear some definite proportion to the current?

Westminster Fire Office Rule.—In 1888 the Westminster fire office issued a set of rules for guiding their officers in regard to electric light installations, in which they demand that the insulation resistance shall in no case be less than 150,000,000 ohms per mile. Surely they have been blindly making extracts from a submarine cable specification. No contractor could be expected, under any ordinary circumstances, to complete his work, including dynamo and fittings, to such a high standard.

M. Picou's Rule.—On Nov. 7, 1888, M. Picou communicated his rule to the International Society of Electricians, Paris. Using the same symbols as in the writer's rule, it is

$$R_1 = k\frac{E}{C},$$

where R_1 = the total insulation resistance of the circuit in ohms,

k = a constant (500) found by experiments with short lengths of wire covered with three layers of cotton wound in reverse layers and pressed between metal plates;

E = maximum e. m. f. of the generator in volts;

C = total current generated or passing through circuits in amperes;

$\frac{E}{C}$ = the resistance in ohms of the whole circuit when the installation is in full working order.

The differences between M. Picou's rule and the writer's lie in the different values given to the constant k, and in the substitution by M. Picou of the total current, C, for the total number of lamps, N, in the writer's rule. There is

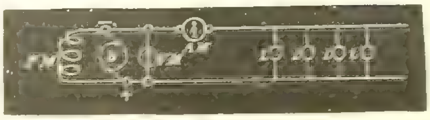


FIG. 4.

[illegible]

[illegible]—In [illegible] 1888 [illegible] "[illegible] Fire Risks," and Rule 16 states that "the insulation of a system [illegible] leakage [illegible] parallel working from one conductor to the other when all branches are switched on, but lamps, motors, etc., removed) does not exceed [illegible] part of the total current [illegible] for the supply of said lamps, motors, etc.; the test being made at the usual working [illegible]. This rule includes all kinds and systems [illegible], and it is very neatly and concisely expressed. Some persons have, however, a difficulty in understanding how the [illegible]th part of the total current is to be tested [illegible] ascertained, and others do not see exactly how the test is to be applied to different parts of the circuits at the usual working e. m. f. [illegible] the installation is put into working order.

If the rule had also been put into the following form, with a table giving the insulation resistances required for a few of the more common electromotive forces and currents, or a number of lamps, it would no doubt have recommended itself more readily to those [illegible] with the form of expression used in the rule. Using the same symbols as before, we have

$$\frac{1}{5000}C = \frac{E}{R},$$

$$\therefore R = 5{,}000\frac{E}{C}$$

which is the form of expression used before, and most easily applied. This gives a constant ten times as great as M. Picou's, and about one-tenth that of the writer's rule. Which of these constants is most in accordance with good practice?

Table of Insulation Resistances required by the Society of Telegraph Engineers and Electricians' Last Rule, viz., the leakage of any part of an insulation not to exceed [illegible]th of total current supplying that part, or $R = \frac{5{,}000\ E}{C}$

FIG. 5.

Number of Amperes in Circuit.	For [illegible] Volt Lamps	For [illegible] Volt Lamps	For [illegible] Volt Lamps	[illegible]	[illegible]
	Ohms.	Ohms.	Ohms.	Ohms.	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	10,000	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible] Tests.—The ordinary Wheatstone bridge [illegible] is the handiest [illegible] method [illegible] resistance [illegible] high for the battery power [illegible]. These tests are [illegible] to explain them here. [illegible]

When [illegible] at the results [illegible] ampere [illegible] First [illegible] as shown in Fig. 3. [illegible]

[illegible] the voltmeter V M. This gives us $\frac{L}{C}$.

[illegible] Fig. 4, with one side to earth, having previously ascertained its resistance, r, [illegible] and see that it is [illegible] earth exists in the [illegible] deflection on the [illegible] corresponding to the [illegible] is represented by [illegible] its terminals.

[illegible]

[illegible] coefficient of the insu[illegible]

[illegible] standard con[illegible] ascertained it right as far as [illegible]. Of course this does not [illegible] place between the [illegible] system, or between the shunt and the series windings of the dynamo. To ascertain the [illegible] disconnect all the lamps and insert the voltmeter first in the forward lead, and secondly in the [illegible] we get any leakage [illegible] when the dynamo is run at its normal speed. [illegible] leakage between the shunt and series wind[illegible] must be had to the Wheatstone bridge test. No doubt some of the members will suggest other practical tests, as well as give their experiences of how the insulation resistance of installations [illegible] happen to be intimately acquainted com[illegible] herein mentioned, as well as how they stood the test of time and wear and tear of everyday work. What is chiefly wanted is to ascertain the minimum standard of insulation resistance compatible with [illegible] careful usage.

CORRESPONDENCE.

New York Notes.

New York, Feb. 7.—There are doubtless cranks of all sorts in the west, but an eccentric individual, Henry Winter of Brooklyn, can give his kind many points. The telephone subscribers at Plainfield, where Winter owns some [illegible] state, were greatly surprised a few mornings ago to find that in all parts of the city telephonic communication was cut off. The New Jersey Telephone company was even more astonished when it was found that no message could be transmitted on any of the trunk lines north of the [illegible] showed that Winter had cut down two poles which stood in front of his premises. It appears that he has been at war with the telephone company for [illegible] decision having been reached after the [illegible] carried to the Supreme court, he decided to demolish the company's poles. The company immediately put up the wires and defied Winter to dislodge them. Winter then ordered a constable from Elizabeth to proceed to Plainfield with a corps of assistants, armed with [illegible] to cut the wires and chop the poles to pieces. The result is not yet known, but a conflict is expected. The telephone people say they will arrest any one [illegible] the poles. In the meantime all telephone [illegible] is stopped and the sub[illegible] are loud in their complaints.

[illegible] for the complainant in the suit of [illegible] company against the Wallace Electric Telephone company for infringement of patents, Judge Wallace of the United States Circuit court says that [illegible] essentials in the above [illegible] nor was any[illegible] purpose,' he [illegible] discussion of the [illegible] exhaustively [illegible] for defendant [illegible] to what has al[illegible] of the courts. [illegible] upon the Bell [illegible] to obtain now, unless it [illegible] the state of [illegible] strange if any[illegible] the most [illegible] that the [illegible]

[illegible]

was no reason why Judge Lawrence's opinion as to the validity of the board's construction of the act could not be just as weighty given in a chambers motion as upon a trial. "If the court in another branch," he continued, "has expressed its decided opinion that this Board of Electrical Control is the arbitrator, vested by the act of the legislature with power to decide definitely that such and such a subway along any street is sufficient and ready for occupancy by the wires of these companies, it would seem to me most useless for the court to sit here and hear the testimony of experts, always differing according to the side they are on. I am decidedly against the relief asked by the complaint for an injunction against the subway commissioners restraining them from all acts tending to give other companies privileges which they do not give this company." After taking a recess to consider Judge Lawrence's decision and the acts of the legislature in deciding a motion which had been made by Mr. Trull on the part of the commissioners, Judge Beach decided that the only question to be considered was whether or not the board had removed or interfered with the company's poles and wires. Testimony to show the insufficiency of the subways, or that the board had granted greater or other privileges to other companies than to the United States company, he refused to consider. The proceedings were thus simplified. As the case now stands, the outlook is not promising for the company.

Mayor Grant has vetoed the resolution permitting the department of public parks to provide an electric plant for the lighting of the Metropolitan Museum of Art without the public letting and contract required by law.

There was a very interesting meeting of the Photographic section of the American Institute, February 5th, when Dr. Milton J. Roberts illustrated the application of electricity to the taking of flash-light pictures. Dr. Roberts spoke at length on the importance in medicine and surgery of having a record of verified data upon which to base an opinion, and said that a photograph was often of material aid to the physician in that connection. The lecturer exhibited his method of taking pictures with a flash light, by which the shutter on the camera was moved, and the magnesium powder exploded at the same instant by means of an electric current. The shutter movement was accomplished by means of a temporary magnet placed next to the shutter and connected with a simple mechanism, which would move the shutter as the current was turned on or off. Another wire from the battery was connected with an elliptical-shaped pan in which was placed the powder, the current heating a steel wire, which ignited the powder. Back of the pan was placed a polished reflector, by which much light was saved. A successful picture of the audience was taken, and O. G. Mason also took flash-light pictures with the bulb apparatus. It requires a small battery only to work the apparatus, three cells being sufficient to make an adequate current. The value of this process to the surgeon and the physician can hardly be overestimated.

Prof. Daniel C. Eaton of the scientific department of Yale university has presented the legislature a remonstrance against the granting of a charter to a newly organized street railway company in New Haven, which purposes introducing the overhead wire system. Professor Eaton advocates the use of the storage battery system on the ground that it would insure safety to the public. P.

Jefferson City, Mo.

Jefferson City, Mo., Feb. 9.—The committee on municipal corporations heard arguments last Wednesday on the proposed legislation reducing charges for the telephone service in this state. George F. Durant, of St. Louis and W. W. Smith, manager of the Kansas City office of the Missouri & Kansas Telephone company, endeavored to convince the committee that $100 a year for a telephone in St. Louis was not an exorbitant price; also, that the greater number of subscribers an exchange had the less money the company made per telephone. In other words, there was more money to be made operating an exchange with 100 instruments than if it had 1,000.

Mr. Dempsey of the committee asked Mr. Durant if he followed the argument to its logical conclusion, if it did not mean that if the business of the telephone company kept on increasing it would eventually bankrupt the company.

Mr. Durant said that was true if they did not increase the rates, and in support of his argument he furnished the committee a [illegible] of figures in reference to the [illegible] of the company, its liabilities, [illegible]

[illegible] of the Kansas City Telephone company [illegible] the Kansas City company had not declared [illegible] St. Louis company, and that [illegible] the rates. [illegible] he did not want to [illegible] he wanted to [illegible] telephone rate to [illegible]

all over the state the telephone companies would take out all their telephones and compel the people to do without the instruments.

[illegible] appeared in the interest of the Telephone Protective association of St. Louis, presented [illegible] with the chairman.

The citizens of Sedalia sent a petition to the house last week asking for the passage of a bill fixing the maximum charges for telephone service at $4 per month in cities of 100,000 inhabitants, and $3 per month in cities of less population.

C. H. Mab[illegible] of Fort Scott, Kan., in connection with Philadelphia capitalists, has signed contracts for the purchase of the entire stock of the Independence, Mo., Gas & Coke company, the Independence Water company, and the Independence Electric Light & Power company. The new company will erect a water tower, put in new pumping machinery, and make such extensions as are needed for a full and perfect water supply. The system of manufacturing gas will be changed and necessary extensions made. The electric light plant will be moved from its present location to a vacant lot adjoining the gas works, and the entire system will be overhauled and improved. These improvements will involve an outlay of over $100,000. The new company will take possession about June 10th. The contract calls for over $200,000.

A movement is on foot among the business men and capitalists to establish an electric light plant at Kirkwood, Mo. The matter is in the hands of Cortez A. Kitchen, who is forming a stock company, to be known as the Kirkwood Electric Light & Power company. The capital stock of the company will be $5,000, to be divided. It is estimated that this capital will install a plant of 500 16-candle power lamps.

The Bell Telephone company last week compelled the removal of the Cushman system from Chillicothe, Mo.

Indianapolis, Ind.

Indianapolis, Feb. 8.—The council committee on light has ordered gas lights discontinued on streets lighted by electric light. So far 220 gas lights have been abandoned, and 200 more will be soon.

The Brush Electric Lighting company has been instructed to put in more lights in the south part of city. The light is giving general satisfaction.

After some delay the city council of Columbus, Ind., has renewed its annual contract with the Citizens' Electric Lighting company at $52 per light for 50 lights, on the midnight schedule.

Another bill, regulating telephone tolls, has been introduced in the legislature. It provides following rates for rental of instruments: When one instrument is used, $4.50 per month; more than one, $4 each, and if more than fifteen calls a day are made, $5. If on line extending three miles or more from central office, $6 a month may be charged. One public telephone may be maintained in each block and toll of 5 cents charged for each message. It also provides for fine of $10 to $50 in case of overcharge. M.

Kansas City, Mo.

Kansas City, Mo., Feb. 9.—A meeting was held last week to take the initiatory steps to compel the East Fifth street dummy line to abandon the use of steam in operating its road, and substitute electricity. Funds will be raised to prosecute the legal battle on behalf of those who own property along the line of the railroad. A remonstrance was prepared and signed by every individual present.

C. D. Crandall, the secretary and treasurer of the Missouri & Kansas Telephone company, states that the company has under consideration the report of the telephone committee of the Commercial club, but that no official action will be taken until the board of directors meets in April.

The Central Waterworks Construction company, recently incorporated under the laws of Kansas, will make a specialty of electric plants. It has elected the following officers: President, O. B. Gunn; vice-president, O. N. Moyer; treasurer, J. C. Gunn; secretary, H. B. Pomeroy; chief engineer, W. Kiersted.

Louisville, Ky.

Louisville, Ky., Feb. 9.—The Louisville Electric Light company recently elected the following officers: Charles D. Pearce, president; William Tillman, vice-president; T. C. H. Vance, secretary, and J. G. Gaylord, manager.

The G. T. Woods Manufacturing company of Newport has filed articles of incorporation, and will engage in a general electrical business. The capital stock is $500,000.

Lexington is following Louisville in the adoption of the fire alarm bell and the arrangement of the electric system in the engine house. At the last meeting of the city coun-

cil it was provided that $500 be appropriated for this purpose.

The demand for better lights at Frankfort has become so urgent that the Capital Gas & Electric Light company has ordered an engine and two 25 light dynamos of the Western arc system.

Thomas H. Fearcy of Nashville, agent for the Thomson-Houston Electric Light company, visited Paris, Ky., recently with a view of introducing electric lights there.

The citizens of Cynthiana have been discussing the respective merits of electric light and gas for some time. Messrs. Wells & Boyd, agents for the Queen City Electric company, made a public exhibition of their lights recently at the Opera house. A dynamo was placed in a shop on the other side of the street, and the Opera house was illuminated. Lights of different shades and colors were suspended about the room. The mayor, members of the city council, and prominent citizens of the town were present, and all said they were highly pleased with the exhibit. The company wants to introduce its system and organize a local company to buy the plant, the cost of which is estimated at $10,000.

Mayfield, a thriving town of 5,000 people in Western Kentucky, demands electric lights.

Messrs. W. B. De Munn and T. B. Conley, who have been superintending the erection of the electric light machinery at Paducah, have finished their task, and yesterday departed to begin a similar work at Washington, Pa.

A.

THE ELECTRIC LIGHT.

Boone, Ia., will shortly be lighted by electricity.

The city of Baton Rouge, La., will be illuminated by twenty Van Depoele arc lights.

Massachusetts has now seventy-eight electric light companies against fifty-six in 1887.

An electric light plant of the Edison system is to be installed shortly at Laurens, S. C.

The Westinghouse company is endeavoring to establish a 10,000 light plant in the metropolis.

The Edison Light & Power company, Albany, N. Y., will increase its capital stock to $60,000.

The municipal authorities of Rome, Italy, have recently appointed a committee to study the question of lighting the entire city by electricity.

The Edison-Swan company will establish a central station at Manchester, Eng , in the heart of the city, at an estimated expense of $200,000.

The San Bernardino Electric Light & Power company has offered to furnish the city of Riverside with ten arc "moonlight schedule" lamps for $100 per month.

The enormous ferry boats which have been constructed for the new ferry service across the Thames are fitted with electrical apparatus for lighting them on deck and below.

The Taylorville Electric Light & Power company, capital stock, $20,000, has been incorporated by W. W. Anderson, J. Bourne, R. H. Browne, J. G. Drennan, and W. H. Kirkwood.

The contract for lighting the steamer now in course of construction for the Detroit & Cleveland Steam Navigation company has been awarded to the Brush Electric company of Cleveland.

The Victoria Art galleries at Manchester, Eng., will probably be lighted by electricity soon. The cost of the plant would be about $14,000, and the operating expenses about $3,000 per year.

The Van Depoele system will continue in operation in the city of Elgin, Ill., as the council has voted to buy the plant of the Elgin Electric Light company, and retain the tower system of lighting.

The Baton Rouge, La., Electric Light company has contracted with the Van Depoele Electric Manufacturing company for an 80 arc light plant and 500 Mayo incandescent lamps for immediate use.

The city of Clinton, Wis , has made a contract for ten arc lights for public use with A. Woodard, who has just purchased a 20 arc light and 300 incandescent light plant of the Van Depoele Electric Manufacturing company of Chicago.

The Brush Electric company of Cleveland has recently received another order from the California Electric Light company for a new plant, consisting of a 60 to 65 light arc machine, with lamps, etc. This plant is to be used on the Pacific coast.

The city of Lockport, N. Y., has decided to establish an electric light plant for public lighting, and at a recent meeting a resolution was passed that a bill be introduced in the legislature empowering the common council to bond the city for $30,000 to enable it to purchase a plant.

The Heisler Electric Light company has received a contract from the city of Portland, Ore., to furnish 125 thirty candle power street lamps. The circuits are twelve miles in length. According to the local papers the lights are very satisfactory to the council and citizens. The plant and circuits will be enlarged and extended by H. A. Hogue, proprietor [illegible] station, [illegible] private house lighting [illegible] station. [illegible] large central [illegible] Houston [illegible] Pacific coast [illegible] private house lighting [illegible] central station plant [illegible]

The Coxvera Mining company of [illegible], Central America, has purchased an [illegible] electric light plant of the Van Depoele Electric Manufacturing company of Chicago. The dynamo [illegible] in sections, no piece weighing more than 125 pounds, so that the plant may be conveyed by pack mules over the mountains.

A special meeting of the city council of Lebanon, [illegible] was held last week to receive a proposition from the Westinghouse Electric Light company to light the city by electric light. Guido Pantaleoni, the electrician, was present. A committee consisting of three aldermen and three citizens was appointed to get further information in reference to the cost, and ascertain the sense of the citizens.

According to a Pittsburgh dispatch a distinguished party, composed of the chief of police, chief of the fire department, chief of the electric and patrol systems, and the board of fire underwriters of the city of New York visited that city recently to examine the alternating current system of electric lighting, and compare it with the direct current in use in New York. The visitors were favorably impressed with the alternating system.

The Montreal agent for the Edison Electric Light company has returned from New York, where he laid before Mr. Edison the plan for utilizing the power of the Lachine Rapids and the Isle au Heron, as purchased by the Electric Light company of Canada. Mr. Edison is said to have expressed his surprise that such a motor power should exist near such a city as Montreal, and not be used. He said there would be no difficulty in transmitting any amount of power to the city of Montreal, and promised to prepare a plan for working the same.

A Pittsburgh dispatch under date of February 9th says: "In the United States Circuit court to-day the Consolidated Electric Light company made a motion for a hearing in the suit against the McKeesport (Edison) Light company upon the Sawyer-Man fibrous carbon patent, the testimony in which has been closed in the United States Circuit court The court continued the motion of the Consolidated company until next Saturday, and permitted the Edison company to serve a motion for delay, to be heard at the same time as the complainant's motion for an early hearing.

THE ELECTRIC MOTOR.

Toledo is making a lively fight for an electric railway.

Waterville, Me., is to have an electric street railroad.

There is some talk of propelling the Ashley, Pa., street cars by electricity.

An effort to organize a street railway company to run electric cars between Lowell, Lawrence and Haverhill, Mass., is being made.

Five new cars have been ordered by the Sacramento Electric Railway company. They will be furnished by the Electrical Accumulator company.

The Wooley Electric company of Cambridge has organized, with a capital stock of $14,000, to manufacture sewing machines with motors for operating them.

The coast is now clear for the Rochester (N. Y.) Electric Railway company, the last injunction having been dissolved. The company will renew its operations immediately.

The Seattle Electric Railway & Power company has received its dynamos, steam engine, boiler, four motor trucks, and other machinery for its stationary plant on the water front. The poles are all up, and the cars will be running in about five weeks.

The Newark, O., *American* says: "Benson Bidwell is looking for a live town where the business men wish to offer inducements for him to locate a factory which within a few years would become one of the largest in the country." Mr. Bidwell is anxious to establish a manufactory of his "indestructible porcelain dynamo and motor." The Newark & Granville Electric railway is to be equipped with these new porcelain dynamos and motors.

A special dispatch from Springfield anuounces the introduction of a bill in the legislature providing that any horse and dummy or tramway company organized under general or special laws which has obtained, or shall hereafter obtain, from any corporation the right to locate or construct its road on or along streets or alleys, may use electricity or cable in lieu of animal power on said road. The substitution of such power shall be done under the supervision of proper officials of the cities, towns, or villages.

The New York *Sun* says, after enumerating the many advantages of electricity over steam: All these things are illustrated in the factory of the "C. & C." Electric Motor company, and for that reason, when an exhibition of their plant was given the other night to those interested in electricity, there were many spectators there. The place is the only one in the world, probably, which is worked by electricity in this way—that is, in which the motive power is distributed to machinery in various parts of the building through electrical wires instead of by belts and pulleys.

On Tuesday, February 5th, there was a gathering of prominent street railway men of New England, who had come from all quarters of the six New England states. The object of the gathering was to inspect the electric branch of the West End road at Boston, installed by the Sprague Electric Railway & Motor company, of New [illegible] the two majestic high- [illegible] steam pump, etc. Adjoining the power station a new car-house has been erected with capacity for 26 cars. The cars [illegible] inspectors can walk and by aid of incandescent lamps with flexible connections can examine and inspect the machinery of each car. After the party had fully examined the workings of the power station, they reboarded the electric cars which were standing in waiting outside, and were carried quickly out Beacon street and Harvard avenue to the terminus of the road at Oak Square, Brighton. On the return trip the cars were speeded to ten or twelve miles an hour in places. Each of the cars was brilliantly lighted by five incandescent lights of 16-candle power each. Not the least enjoyable feature of the entertainment was the collation which was provided for all the guests at the Hotel Thornedike. The guests and visitors were full in their praises of the operation of the road.

THE TELEPHONE.

The advance in telephone rates in Brooklyn affects only new subscribers who do not make five years' contracts.

Subscriptions for a new telephone company in Mexico are being solicited by merchants who are dissatisfied with the service in the City of Mexico.

The Inter-Continental Telephone company of Caracas, La Guayra, Valencia and Porto Cabello, and suburban districts, reports an increase of 152 subscribers to its system since July 1, 1888. It has been compelled to build an addition to its central office in Caracas, and increase its multiple switch-board capacity.

A dispatch from Washington says: Superintendent Kimball of the life-saving service has about completed his plans for the establishment of a telephone service on Long Island sound. When this is completed it will be connected with the service now in operation in New Jersey, and will also be put in communication with the wires in Connecticut and Massachusetts. Superintendent Kimball is also at work constructing telephone lines along the Atlantic coast. The shores of North and South Carolina are now nearly connected by wire. He intends, before another year rolls around, to have the entire Atlantic coast in telephonic communication.

THE TELEGRAPH.

Two Western Union company linemen lost their lives in New York City recently by the breaking of poles.

It is reported that a new telegraph line will be erected between New York and Chicago in opposition to the Western Union.

The Western Union Telegraph company will reconstruct its entire line between Mobile and Montgomery, using Alabama cedar poles.

The Western Union Telegraph company has been sued at Atlanta, Ga., for failing to deliver a message promptly. An old statute provides that a fine of $100 may be imposed on a telegraph company for each failure to promptly deliver a message.

Miscellaneous Notes.

M. de Freycinet is preparing a project for the definite unification of optic, electric and acoustic signals, which will be put into operation as soon as possible.

The Dallas, Tex., Electrical society is now on a firm footing, and promises to become a flourishing organization. It has established a library, and contributions of electrical works, models, etc., may be sent to the secretary, C. O. Harris.

Capitalists in Zurich and Basle are endeavoring to raise $2,000,000 to establish works by which the water power of the Rhine can be utilized for electrical purposes, but thus far they have succeeded no more than their friends on this side who have been trying to harness Niagara.

The council of the Institution of Electrical Engineers of London has decided to exclude newspaper reporters from its debates. In commenting on this the [illegible] remarks the members [illegible] the institution exists for the sake of electrical engineering, and not electrical engineering for the sake of the institution.

A new process for the manufacture of copper coated steel wire for electrical purposes is being followed in Vienna, in which the steel wire will be coated by spiral winding

[illegible] in all such [illegible] of the cop-

The Central Union Telephone company has applied for an injunction restraining the Electric Street Railway company of Akron, O., from operating its road. The grounds for the action are that great annoyance has been caused the [illegible] greatly interfered with the service since the electric cars were started.

Clifton R. Scudder, on behalf of himself and stockholders of the Excelsior Electric company, has begun a [illegible] the [illegible] Excelsior Electric [illegible] decree that defendants pay to a receiver, to be appointed by the court, whatever sums may be found to be due.

[illegible] fair in New York city [illegible] Chauncey M. [illegible] appropriate address, which was recorded by means of phonographs, and afterward repeated through these instruments to all who desired to hear what the noted orator had to say. Many other electrical instruments of novel design were on exhibition in this wonderful nook.

A Chicago interviewer is responsible for the following: "I am in Chicago," said a New Yorker, "for the purpose of introducing my patent electrical apparatus which will prevent cemeteries from being despoiled by grave-robbers. It will also indicate if a body has been buried alive. I sold [illegible] is now used in Woodlawn cemetery. The apparatus is exceedingly simple. Wires are placed around the wrists, feet, ankles and [illegible] slight movement of reanimation, an electric bell, connected by a wire with the coffin, in the sexton's house, gives the alarm, and by turning to the register, similar to that of a hotel, he sees at [illegible] are tampering with, or when [illegible] alive. A small tube, containing oxygen gas, capable of sustaining life for twenty-four hours, is placed at the head of the corpse, and if there be a movement this gas is released, the bell to the sexton's house is rung, and if that is not responded to the bell in [illegible] in motion."

Business Mention.

The Pond Engineering company of St. Louis, Mo., has established a branch in Omaha, Neb.

The carbon business of the Brush Electric company has grown to enormous proportions. Over half a million carbons are occasionally shipped from the Cleveland factory alone in a single day.

The Fishkill Landing Machine company manufacture an improved form of the Fishkill-Corliss horizontal engine designed especially for electric light purposes, which has many excellent points.

The New York Belting & Packing company report a brisk demand for their vulcanized rubber belting with smooth metallic surface, which they now manufacture especially for electric lighting.

The Sperry Electric company of Chicago has issued a neat pamphlet containing considerable valuable information concerning electric lighting in general, as well as an explanation of the most prominent features of the Sperry system.

The Central Electric company of Chicago has just made arrangements for the exclusive sale of the Cleveland incandescent and arc light switch. The territory covers everything west of the Mississippi river, the states of Illinois, [illegible]

Among the largest and most attractive exhibits at the [illegible] the Okonite company [illegible] cables and water-proof joint and protecting tapes. Capt W. L. Can- [illegible] company.

The Electrical Supply company of Chicago has concluded arrangements with the Cobb Vulcanite Wire company to [illegible] sale of the [illegible] will proba[illegible] Electrical Supply [illegible] show [illegible]igh insulating qualities, as well as

[illegible]

station plants recently installed, and in which the Standard weatherproof line wire has been used, are those at Binghamton, N. Y., Red Cloud, Neb., Beatrice, Neb., Minneapolis, Minn., and one in Texas. The Allegheny Light company and East End Electric Light company of Pittsburgh are using no less than 200 miles of the same wire in the installation of the plant now being erected for the lighting of the city of Pittsburgh under their recent contracts. In fact, all the wire used on this work is being furnished by the Standard Underground Cable company. Two plants are now being installed in Rio de Janeiro, South America, and Havana, Cuba, with this company's wire.

James W. Queen & Co., of Philadelphia, state that Profs. Ayrton & Perry have informed them that they had made new arrangements for the manufacture of their spring ammeters and voltmeters. There is a divided opinion among the electricians as to their actual merits. It may be confidently stated that the principle involved in the Ayrton & Perry technical meters makes them the most sensitive and accurate instruments, provided they are well made in all respects. Profs. Ayrton & Perry give their assurance to Queen & Co.—which firm is the sole and exclusive agent for the United States for their old, new, and newest instruments—that they have engaged one of the most reliable English manufacturing houses to carry on the manufacture of their spring instruments of older patterns, as well as their combination spring instruments, and a voltmeter for direct and alternating current. All these instruments will be of the best workmanship, and furnished with certificates from Profs. Ayrton & Perry as to their accuracy. One of the latest instruments of these two eminent electricians is their secohmeter, an instrument destined to determine co-efficients and self-induction. The alternate current man will find a much wanted and looked for instrument. A full description of this instrument will shortly appear, a number of improvements having delayed this matter considerably. It is understood that in the course of a few weeks there will be a new combination instrument in the market, constructed in their laboratory, and manufactured in their shop. It promises, from what their electrician explained, to be a decided progress in the line of compact testing instruments, combining side wire bridge, rheostat galvanometer and battery, in a box 10x10x6 inches.

Electrical Patents.

Issued February 5, 1889.

397,109. Switch and Cut-Out for Electric Light and other Electrical Devices. Oscar S. Bussmann, Somerville, Mass.

397,111. Galvanic Battery. Edward J. Colby, Chicago, Ill. The carbon plates may be charged so as to vary the carbon surface. The invention is fully covered by six claims, the third of which is: In a battery, the combination of carbon plates with a grooved cover to receive such plates and clamps which securely clamp such plates against the inner surface of said groove at their upper ends.

397,116. Galvanic Battery. Charles E. Egan, Columbus, Ohio. The battery is designed especially for use in car lighting. The last claim reads: A depolarizing liquid for a galvanic battery, containing a compound formed by the action of sulphuric acid on the granules or lumps of nitrate of potash.

397,171 Hose Pipe. Edward H. Crosby, Boston, Mass. The nozzle is provided with an electric generator for signaling purposes between the hoseman and the engineer The claim reads: The hose pipe or nozzle *a* and a support or bracket secured to it, combined with an electric generator held by said support, all as and for the purpose specified.

397,176. Telephone or Analogous Electric System. Anthony B Ferdinand, Oshkosh, Wis By this system any instrument on a line may be cut out when desired for a given length of time and automatically restored to place.

397,194. Multiple-Signal Transmitter. Morris Martin, Malden, Mass. Any desired one of a numberof pre determined signals may be sent over the circuit by this apparatus.

397,218. Insulating Pipe-Coupling. Sigmund Bergmann, New York. The invention relates to coupling pieces used to connect a gas supply pipe with a chandelier used for gas and electric lights.

397,221. Junction Box for Electrical Conductors. William M. Callender, New York, N. Y. The claim reads as follows: The combination, with tubes containing insulated electrical conductors, such tubes being threaded at their ends, of internally threaded junction [illegible] around the [illegible] ends, the said junction [illegible] being made to have and being provided with means for attachment to the tubes, substantially as set forth.

397,235. Method of forming Secondary Battery Elec- [illegible] Philadelphia, Pa. The [illegible] The method of forming secondary [illegible] in warming the mold, [illegible] previously formed pieces of active material [illegible] together [illegible] holding them rigidly in said mold [illegible] so that the active material [illegible] above each other, and finally [illegible] metal around said active [illegible]

[illegible] Robert Wehen Pitt[illegible]

[illegible] Alex Z [illegible] The [illegible] purpose of the invention is to

relieve engineers from detecting the positions of visual signals; this is accomplished by placing in the cabs of engines bells which will automatically give the alarms.

397,280. Phonograph Recorder and Reproducer. Thomas A. Edison, Llewellyn Park, N. J.

397,284. Telephone Call-Box. Amenzo Griffith, Springfield, and Henry A. Burbank, Westfield, Mass. The invention is an automatic ring off device.

397,300. Electric-Wire Conduit. William B. Mack, Boston, Mass.

397,320. Process of Making Dental Plates by Electro Deposition. Joseph G. Ward, Irvington, N J.

397,331. Telephone Circuit and Apparatus. John A. Barrett, Brooklyn, N. Y. The object of the invention is to reduce the effect of induction disturbances upon telephone lines. Of the five claims we give the third: The combination, with a telephonic circuit, of a telephone transmitter, an induction-coil therefor, having its secondary or line helix, which constitutes the source of energy in said circuit, divided at or about its center of resistance, and a receiving-telephone looped or connected to the several terminals, substantially as described.

397,335. Signaling Device for Cable Railways. William M. Bulkley, St. Louis, Mo.

397,340. Dynamo. Robert L Cohen, Camden N. J. The invention relates to ventilating the armature. The last claim is given: The combination of the hollow perforated shaft, the hollow perforated bobbins, and the interposed filling-pieces forming chambers between the bobbins, through which air entering the hollow shaft and bobbins can escape outwardly, all substantially as specified.

397,364. Electric Communicating System. Alfred G. Holcombe, New York, N. Y. This is a police signaling system. Of the fourteen claims the first is given: In an electrical communicating system, the combination, with a source of electric energy, signaling devices located at a central and sub stations, and circuit connections uniting said stations, of electric lamps located in branch lines at the sub-stations and having suitable circuit closing devices, whereby they may be lighted at the will of the operators at the substations, substantially as set forth.

397,385. Cable or Electric Street Railway. William S. Phelps, San Francisco, Cal.

397,392. Armature for Dynamo-Electric Machines. Oliver B. Shallenberger, Rochester, Pa. The invention is especially applicable to alternating current machines and relates to the winding of two sets of coils upon an armature of the cylindrical type.

397,418. Protection for Electrical Instruments. Joseph E. Crandall, Washington, D C.

397,423. Method of Demagnetizing Watches etc John Greaves, St. Louis, Mo.

397,424. Connection of Electrical Circuits. William W. Griscom, Haverford College, and Henry N. Weidner, Philadelphia, Pa.

397,439. Dynamo-Electric Machine and Motor. Francis J. Patten, New York, N. Y The invention relates to the armature winding and connections and to the arrangement of the armature and field circuits with respect to one another. The first and last claims follow: 1. A motor provided with a reversing commutator, the circuit in the motor reversed by said commutator being broken at a point between its terminals and provided with an external loop-circuit, the ends of the loop being in continuous electrical connection with the two sides of the break 18 A dynamo-electric machine or motor having an open point in its field magnet or armature-circuit and a fixed external loop circuit connected thereto, a series of fixed consequent poles in one of its elements, and a commutator for producing alternate polarity in the other element and electrically connected with another external circuit, whereby when the machine is operating alternating currents will circulate in one external circuit and direct currents in the other.

397,443. Secondary Battery. William A. Shaw, Brooklyn, N. Y. A metal or metallic compound is melted, after which the active material is combined therewith, when the mass is allowed to harden.

397 451. Overhead Contact and Switch. Charles J. Vandepoel, Lynn, Mass.

397,461. Electric Converter. Ludwig Gutmann, Fort Wayne, Ind. The first claim reads: An electric converter in which the iron core is made of superposed iron cross-shaped sheets whose arms are bent into two rectangular figures at right angles to each other, and the ends of whose arms all lie in the same or substantially the same plane and in contact with one another

397,466. Printing-Telegraph Andrew T. McCoy, Boston, Mass.

397,472. Telephone Paper Pad Holder. John B. Seymour, jr., St. Louis, Mo.

397,474. Therapeutical Electrode Lucius T. Stanley, Brooklyn, N. Y.

397,479. Incandescent Lamp Manufacture James A. Vandegrift, Newark, N. J. The invention consists in introducing into a glass globe the glass base or stem surrounding the leading in conductors on which the carbon is mounted then closing the globe or neck, and then perforating the same for the passage of the leading in conductors and fusing or sealing in the glass base or stem.

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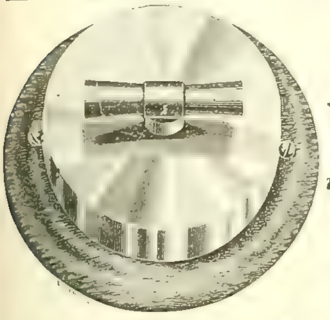

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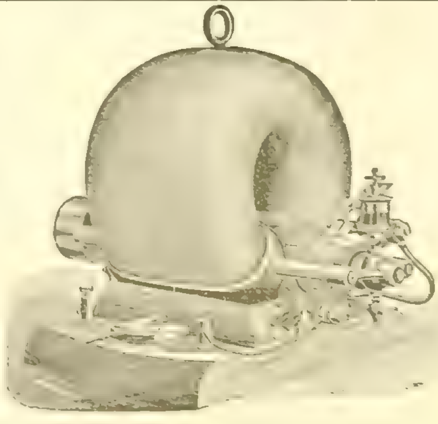

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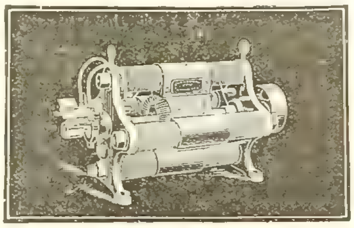

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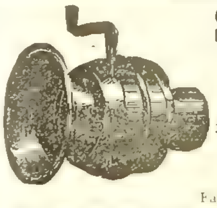

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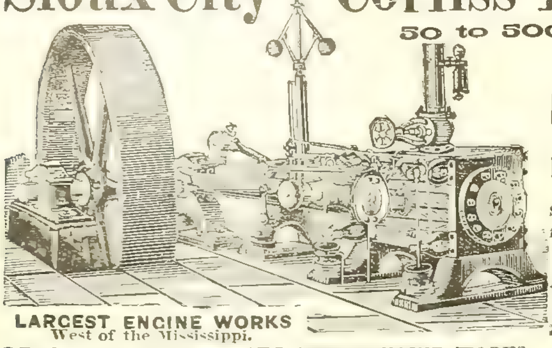

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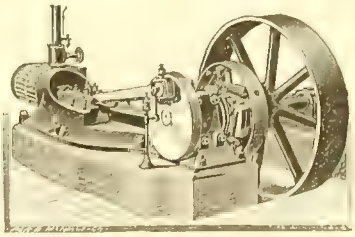

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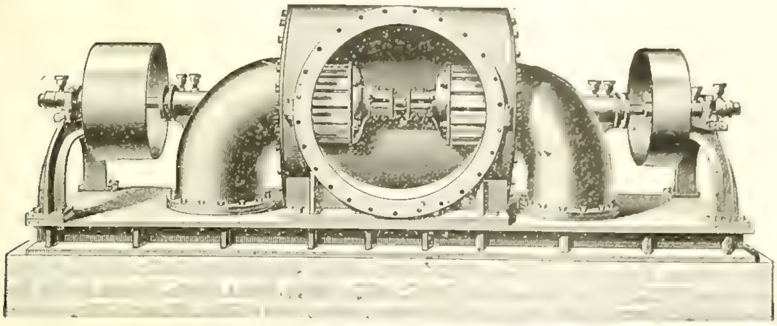

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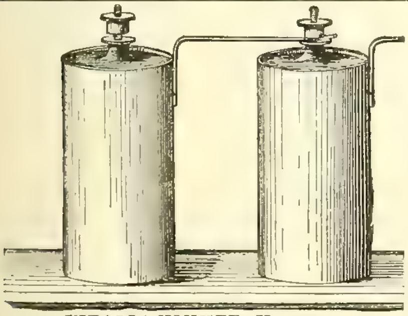

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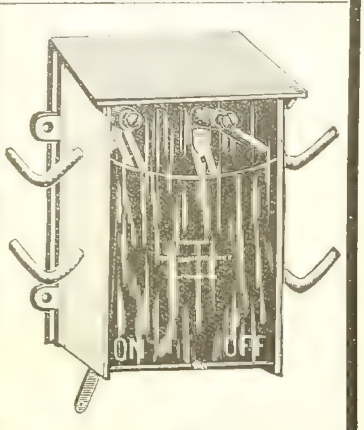

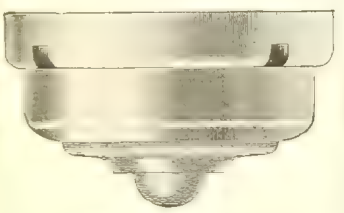

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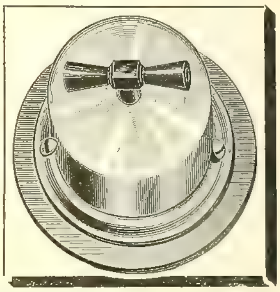

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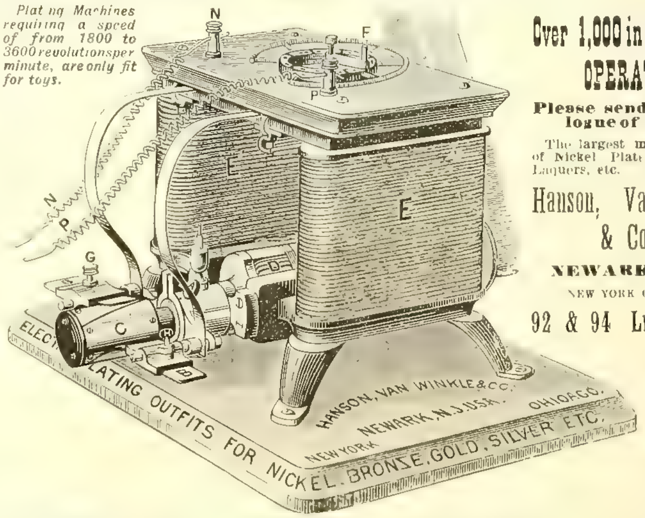

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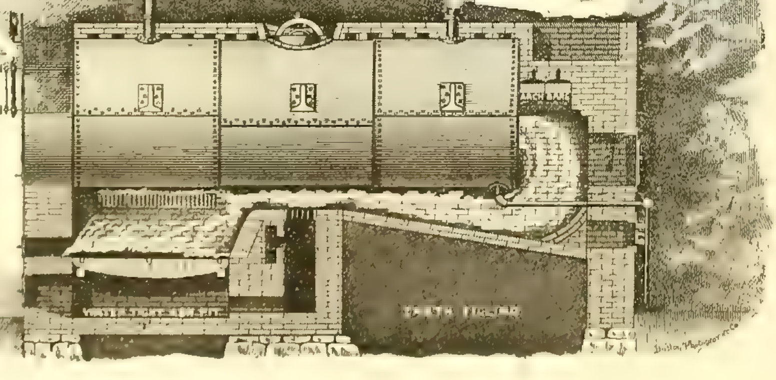

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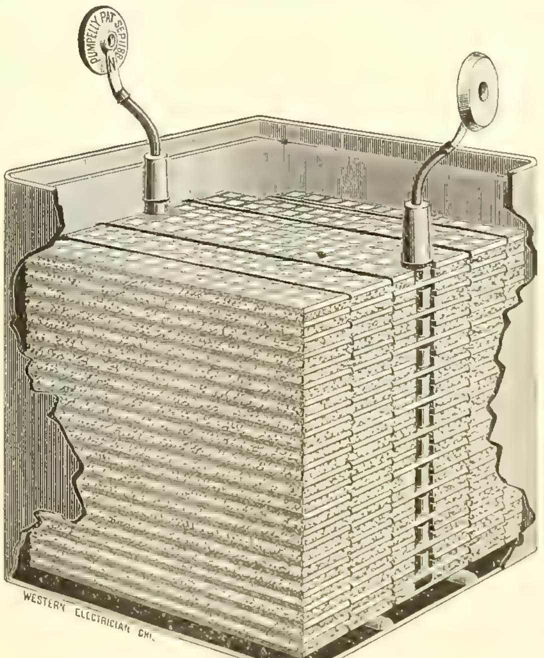

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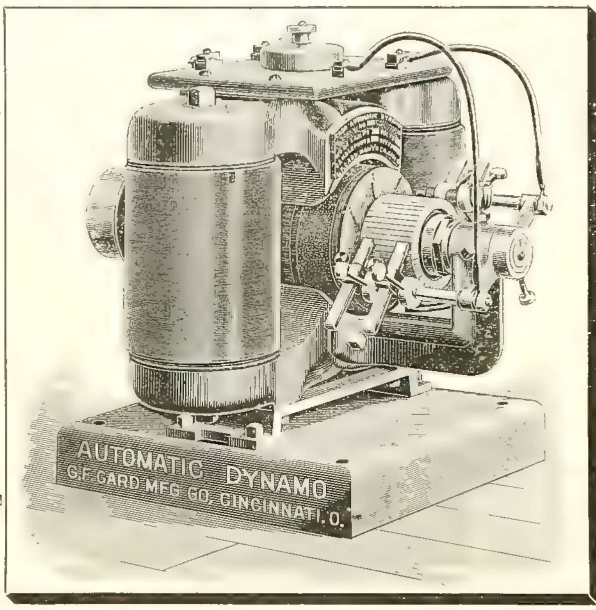

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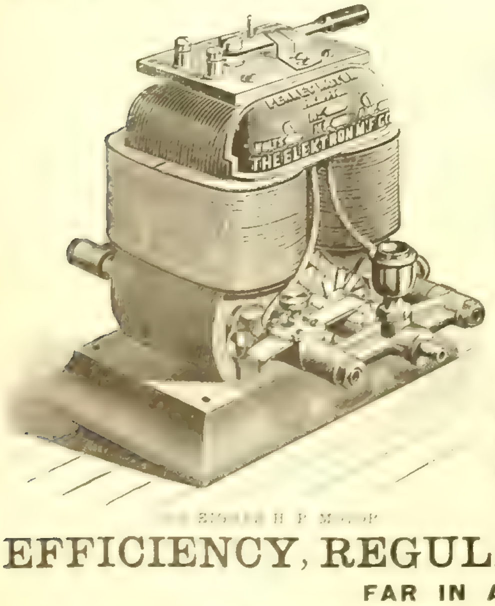

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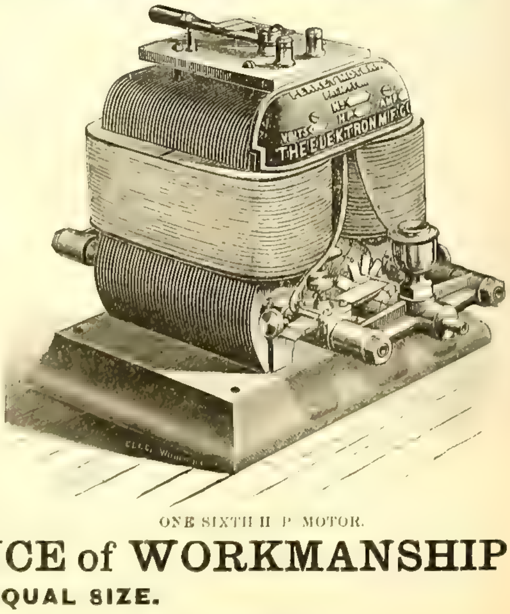

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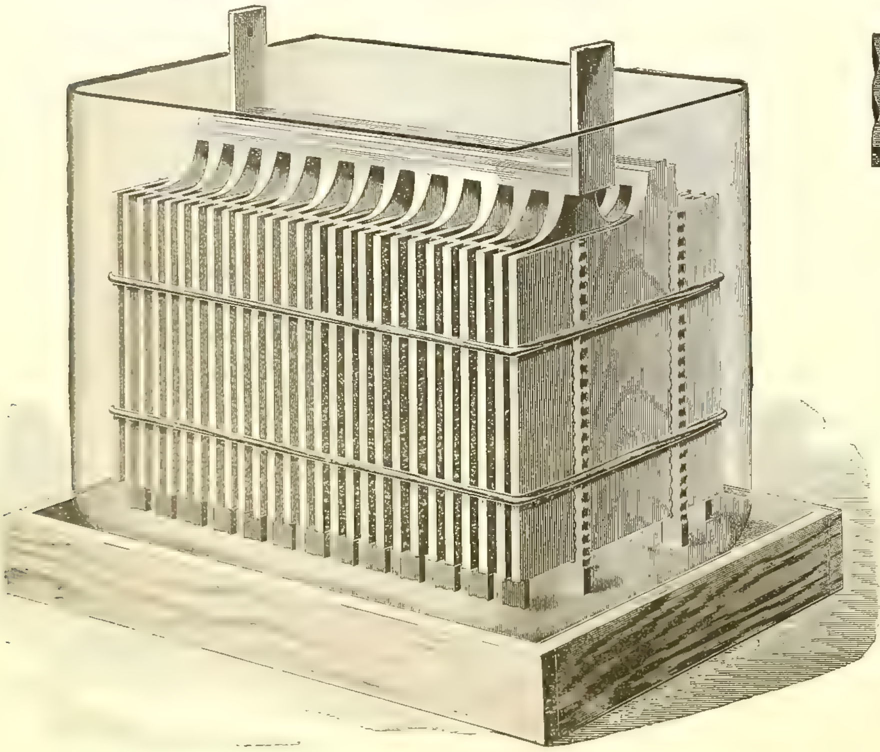

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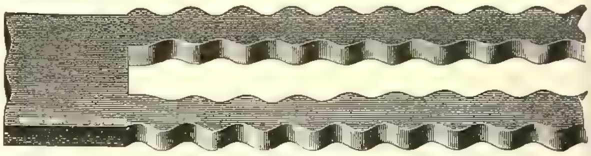

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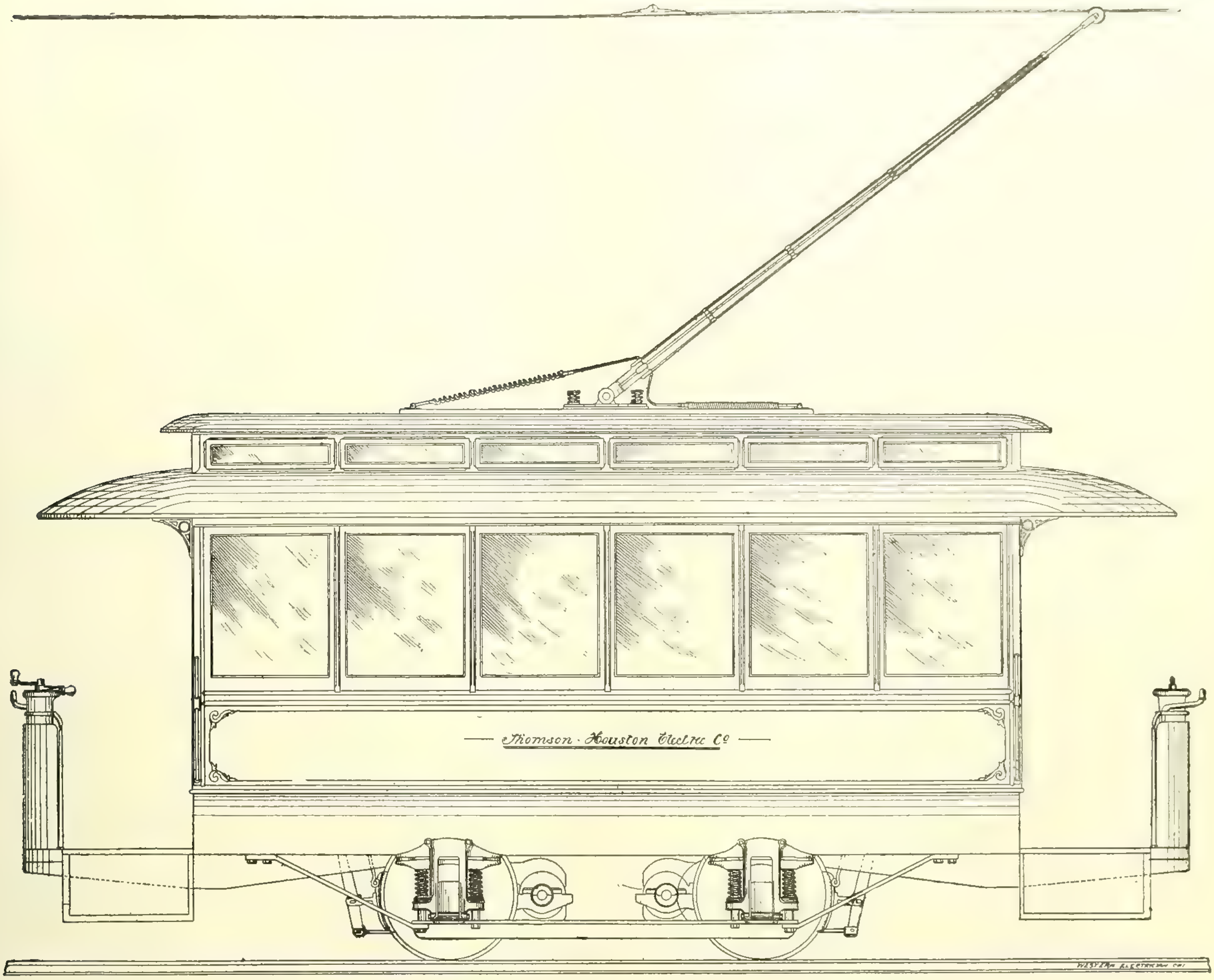

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In the Vulcanite insulation, consisting as it does of a solid tube into which the wire is threaded, an air space is left which is particularly significant, and which should be given special attention. It is exactly the same as though the wire were placed in absolutely dry air, but resting at comparatively few places upon the most perfect insulator, between which and the wire no moisture can ever come. The smallness of the actual contact and the remarkably small number of such contacts combine to make the insulation resistance the highest ever attained. This has been proven by the numerous tests mentioned above. Not only is the insulating resistance brought to an unusually high point by the existence of this air space, but also to this may be traced the remarkably low inductive capacity of the wire. The fact of a quarter of a mile of this cable, after being immersed in water for some days, measuring 102,000,000,000 ohms, and having at the same time a capacity of .055 of a microfarad only, indicates progress that marks a new era in insulated wire manufacture.

The applications of this wire are many and varied. The insulation is made of pure vulcanite. This vulcanite is the only known substance that will withstand the strongest acids, some of which will penetrate glass. A pure copper wire sheathed over perfectly with such an impenetrable armor is prepared to guard over and protect the insulation of such wire against any fumes, gases, steam or other vapors, drippings, in fact any condition which can possibly exist in and about packing houses, basements, distilleries, malt houses, breweries, or any other of a class of most difficult places of installation of electrical conductors. Saltpeter fumes have no effect whatsoever and cannot get at the wire in any way. As an underground conductor the Cobb Vulcanite wires have advantages which are superior to all others from the fact that the insulation while being electrically the highest, and chemically invulnerable, is mechanically the toughest, and will withstand abrasion and cutting to about the same extent as lead, and when buried in the ground and protected above by guard planks, is absolutely indestructible. The coefficient expansion and contraction of this Vulcanite differs not materially from the wire which it contains, and can cut no figure whatever, from the fact that the wire is perfectly loose upon its interior. It is the only wire which should be used in basements. damp area ways under walks, for all underground work, and in the various places of difficult installation referred to above. It will also withstand sulphur fumes over locomotives, the action of soot, etc., and is valuable therefore for viaducts and bridges. It is the only wire which should be used to come up from area ways, and for lamps along the street, because of the mechanical properties of this insulation.

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A few of the principal points of superiority can be briefly stated as follows:

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Third: Durability, Strength and Flexibility.

Fourth: The insulation is capable of standing 250 degrees of heat without injury, and is not affected by frost or extreme cold.

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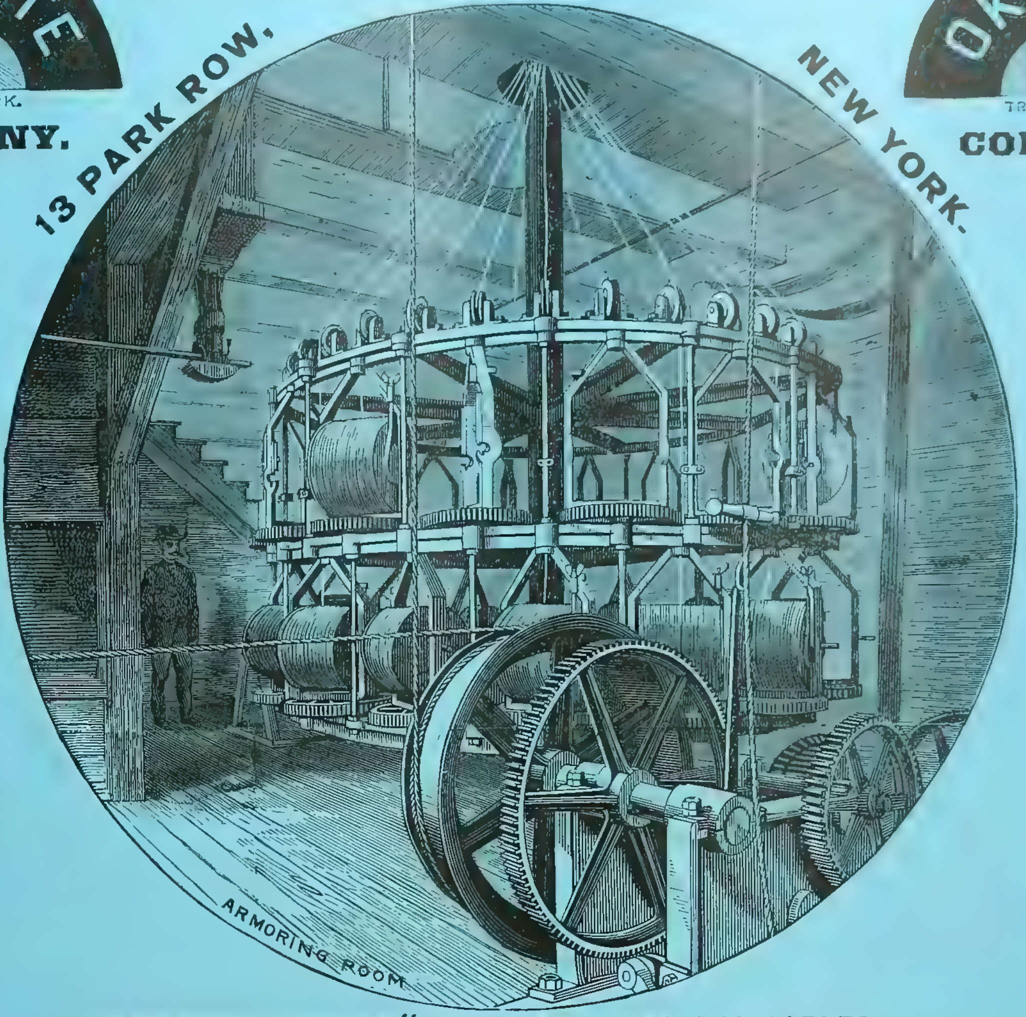

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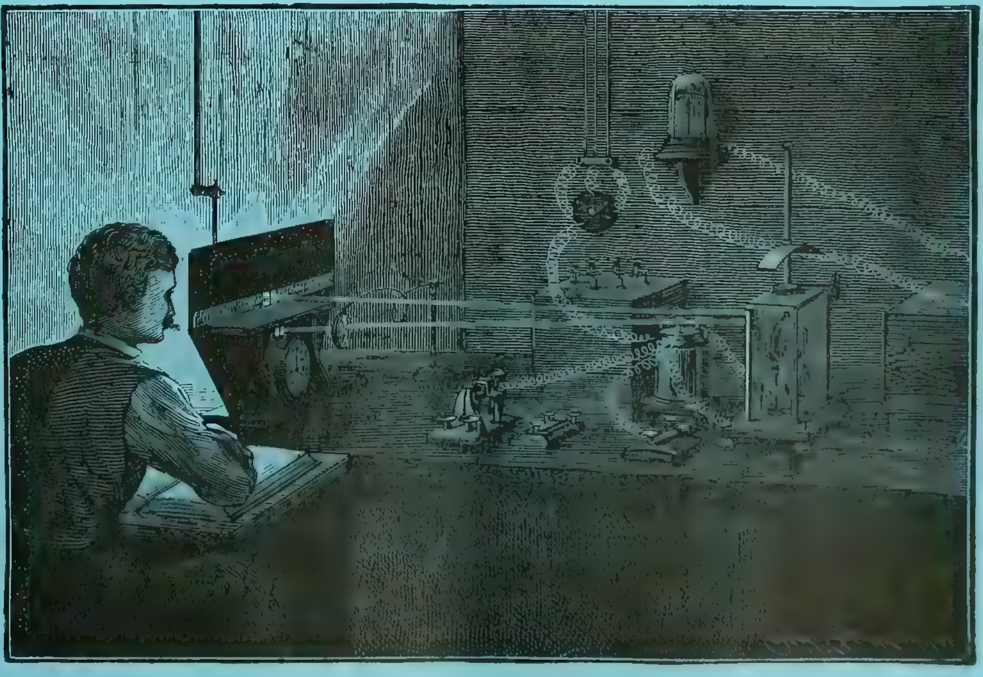

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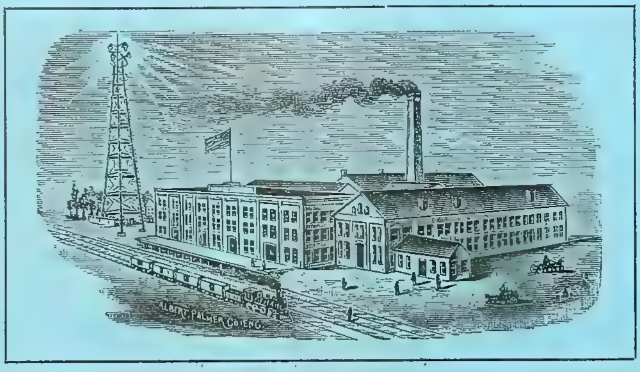

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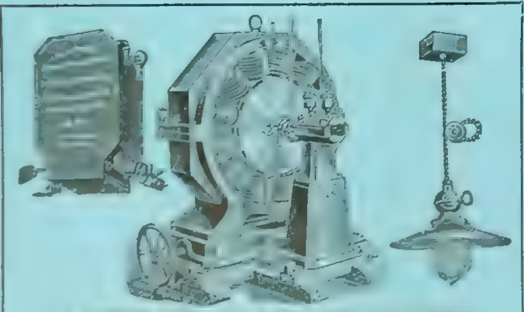

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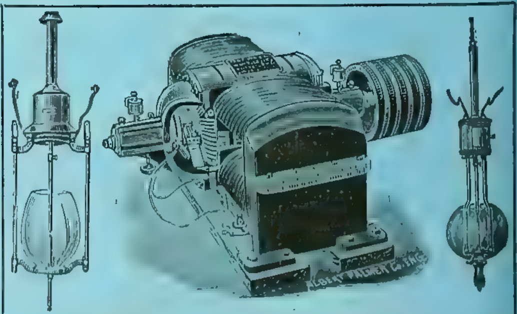

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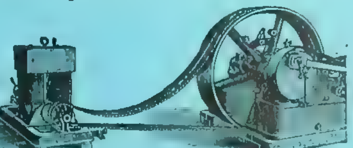

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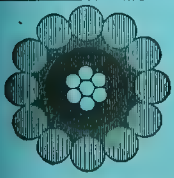

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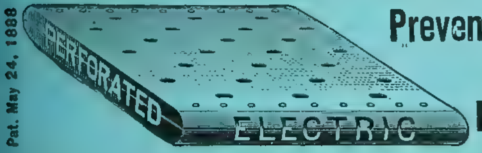

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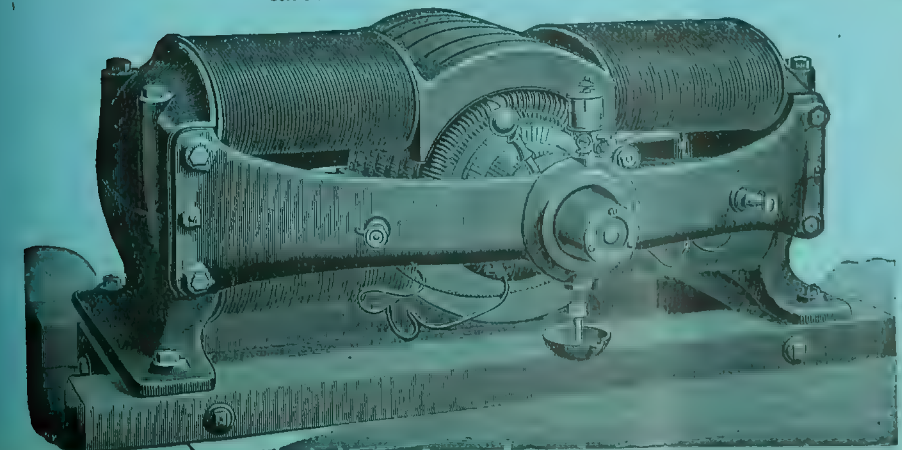

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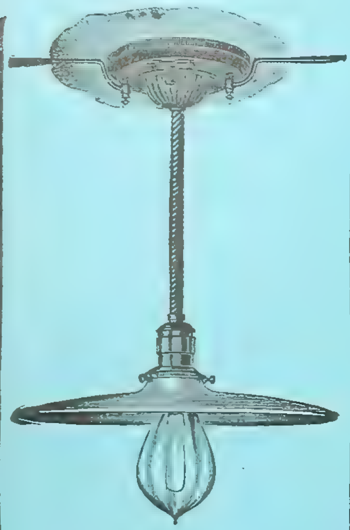

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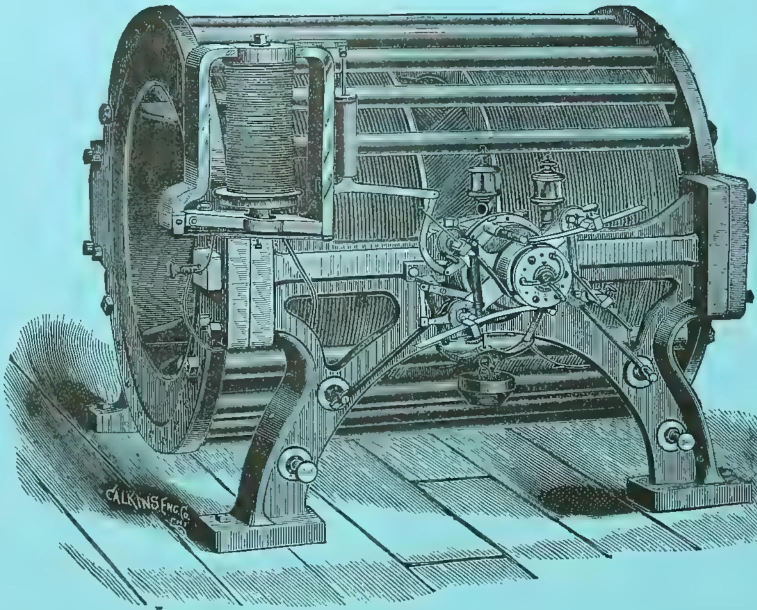

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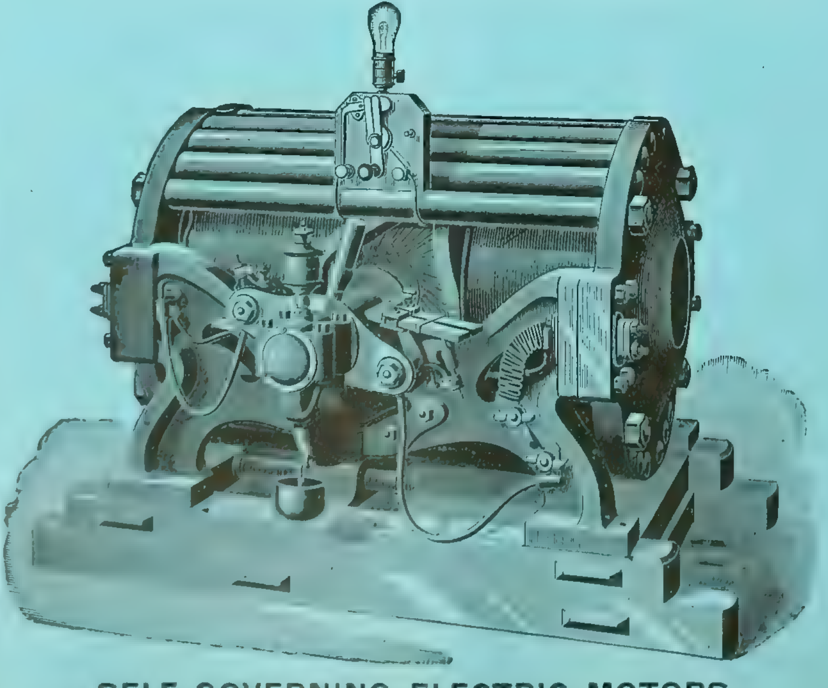

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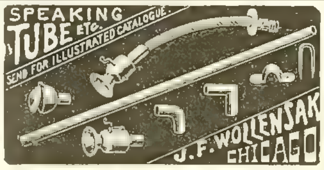

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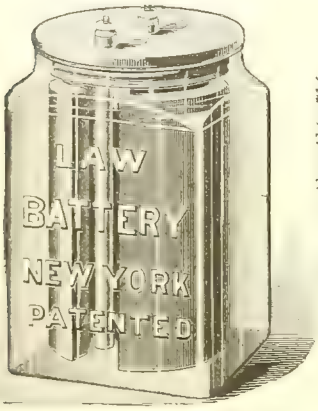

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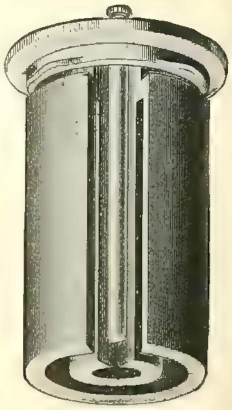

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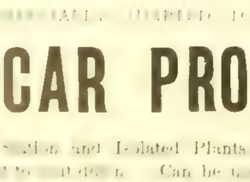

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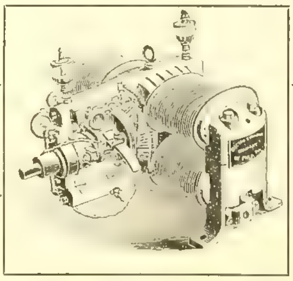

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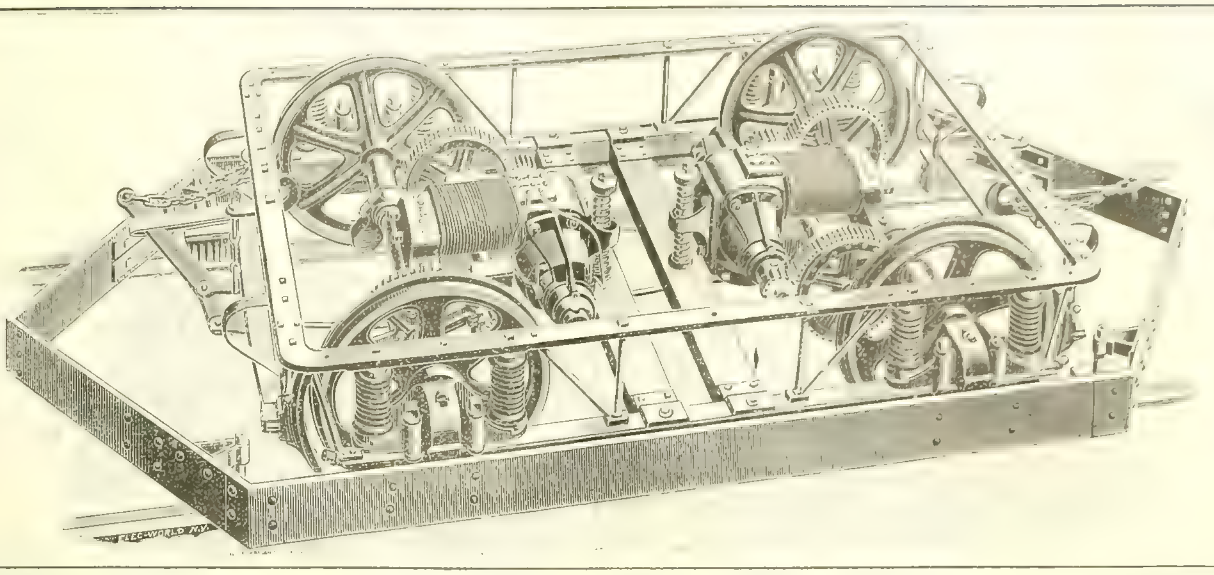

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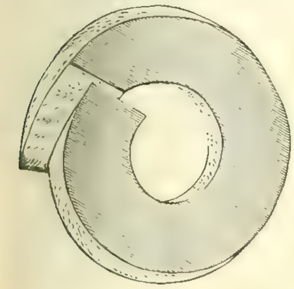

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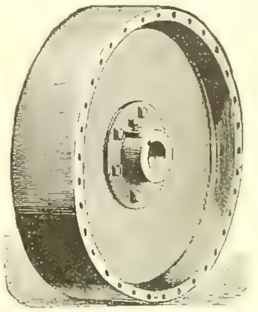

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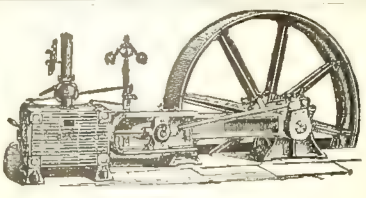

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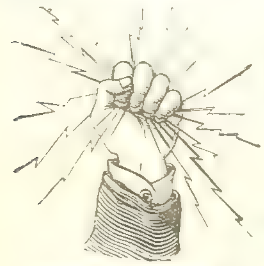

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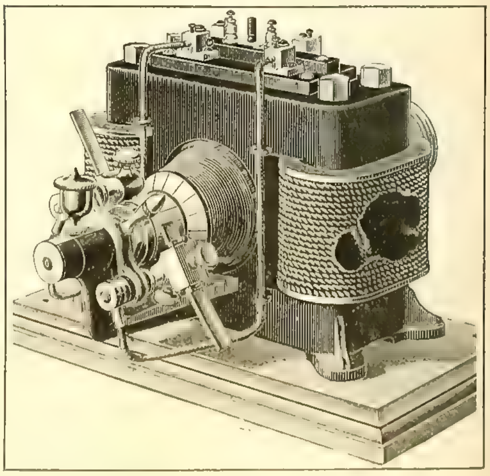

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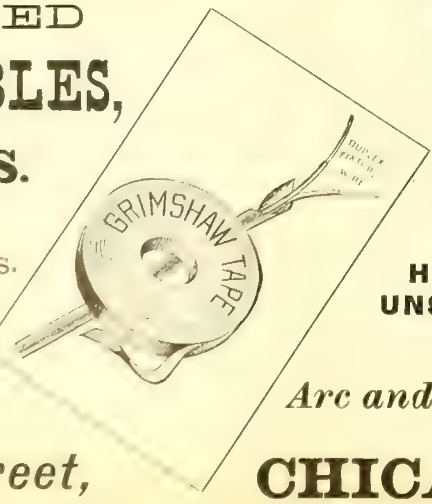

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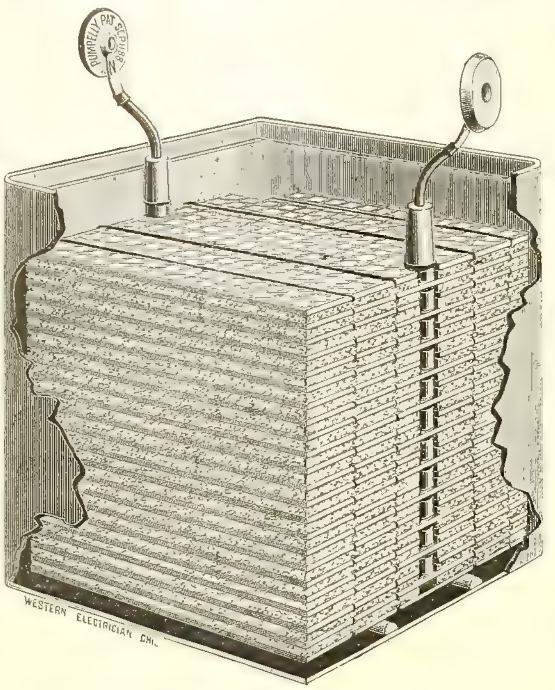

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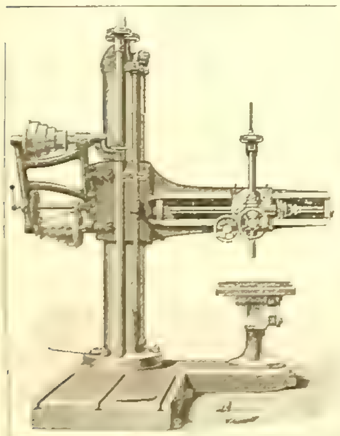

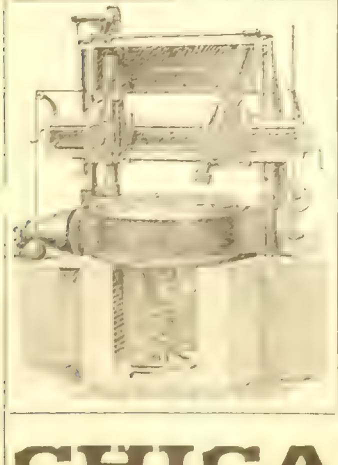

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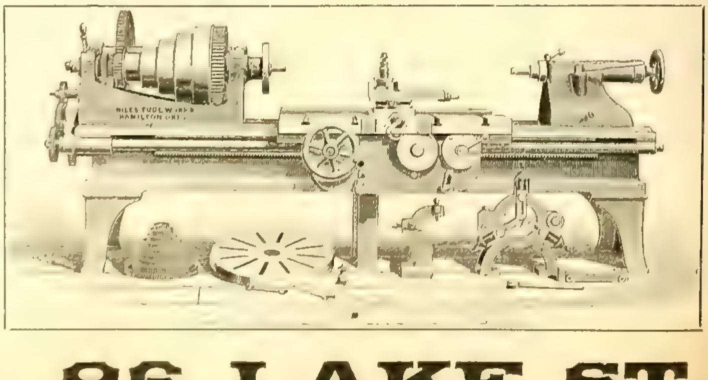

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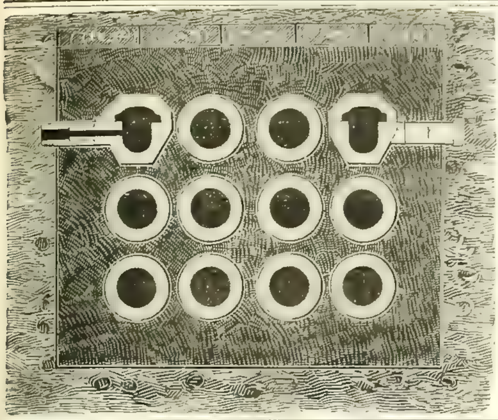

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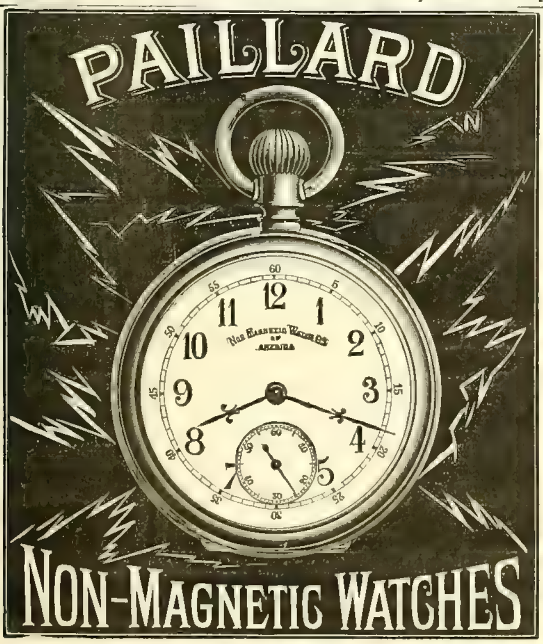

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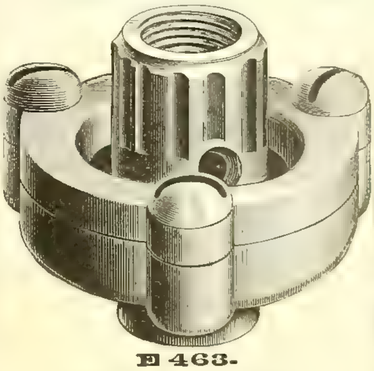

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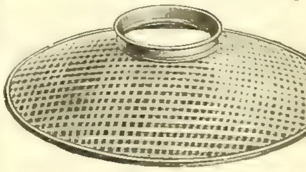

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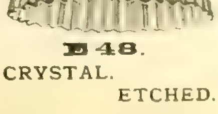

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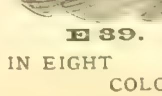

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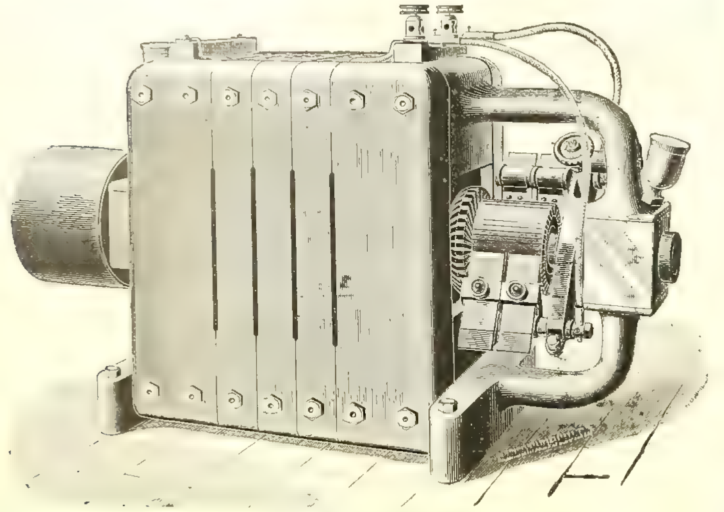

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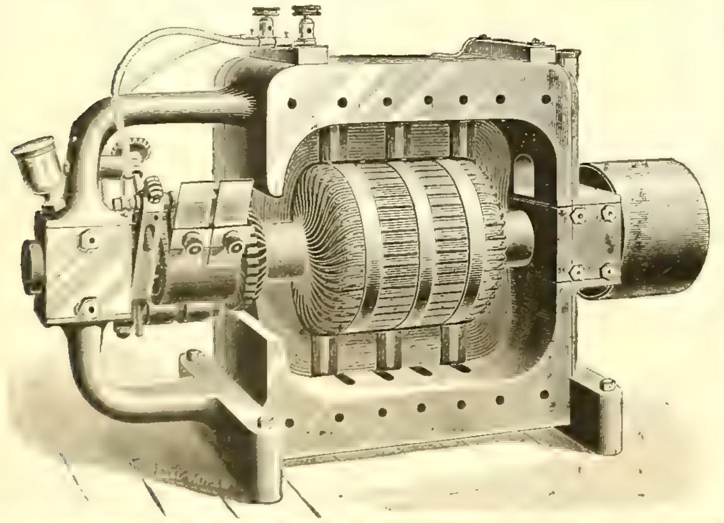

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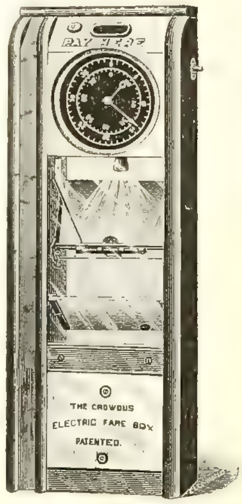

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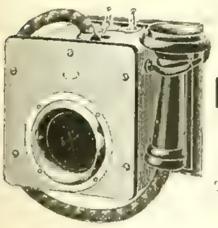

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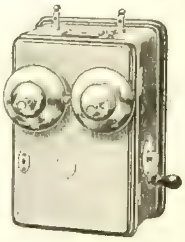

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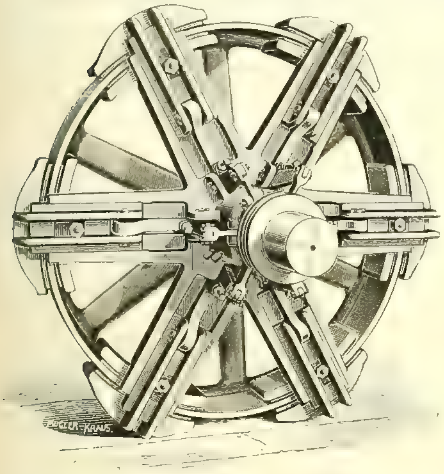

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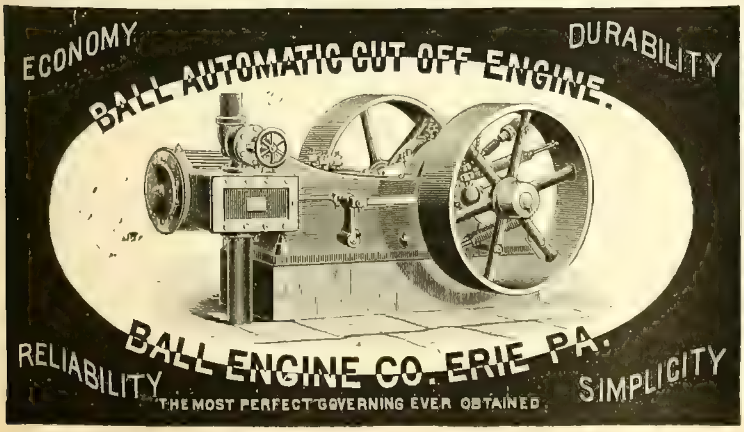

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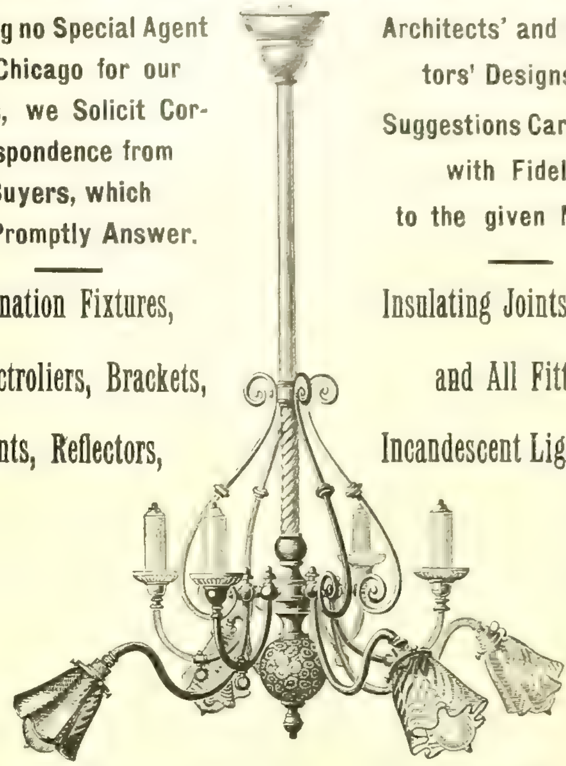

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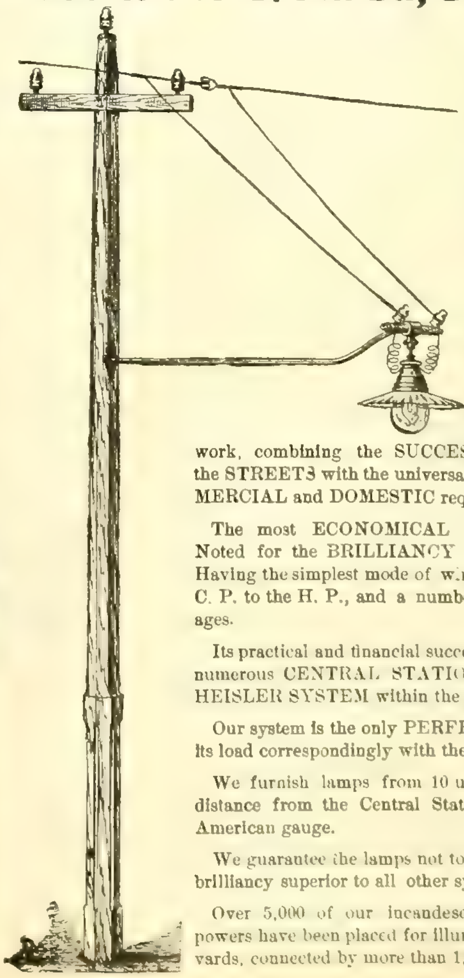

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Its practical and financial success has been demonstrated by numerous CENTRAL STATIONS which have adopted the HEISLER SYSTEM within the last three years.

Our system is the only PERFECT AUTOMATIC, adjusting its load correspondingly with the number of lights.

We furnish lamps from 10 up to 100 C. P. to any desired distance from the Central Station on a single wire, No. 8 American gauge.

We guarantee the lamps not to blacken and to maintain their brilliancy superior to all other systems.

Over 5,000 of our incandescent lamps of various candle powers have been placed for illuminating the streets and boulevards, connected by more than 1,500 miles of line wire circuits

MACRAEON STORAGE BATTERIES

FOR ELECTRIC LIGHTING.

The MACRAEON STORAGE BATTERIES do not "buckle," "blister" or "sulphate"—are the simplest in construction are made with **CLOSED METAL BOXES**—require less attention, and will last longer than any other battery in the market, being practically indestructible and of great efficiency.

These Storage Batteries can be Profitably Used for:

1. Incandescent Lighting on Arc Circuits everywhere using the same Dynamo and power while idle during the day, for charging the Batteries.
2. Incandescent Light Plants, whether **isolated** plants or **central stations**, can be doubled in capacity by using the Macraeon Storage Batteries.
3. **Surplus Power.** Steam or Water, even irregular, wherever it can be had, in Factories, Breweries or business buildings, can be utilized to great advantage and profit by storing electricity during the day for lighting the place or neighborhood at night.
4. Storage Batteries can also be used for **steadying** incandescent or arc lights when run direct from the dynamo.

Incandescent Lighting from the Macraeon Storage Batteries is UNIFORM, STEADY and RELIABLE. No Flickering, less Breakage of Lamps, and, like gas, the light is always on hand day or night.

CORRESPONDENCE SOLICITED. ESTIMATES FURNISHED.

Complete Installations made, including Dynamos and Motors. Special terms to Electric Companies, Contractors and Supply Agents. Address

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7 Wall St., NEW YORK.

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OF

CLEVELAND, OHIO.

MANUFACTURERS OF

BRUSH ARC

AND

Incandescence Electric Lighting

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ELECTRIC MOTORS!

CARBONS FOR ARC LAMPS, ETC.

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for Manufacturing Establishments.

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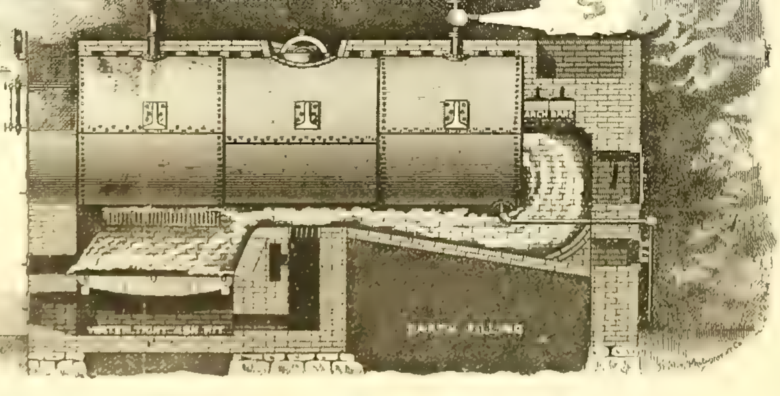
Electric Light and Power Stations.

Economy of fuel
with increased capacity
of Steam Power.



THE JARVIS BOILER SETTING HAS NO EQUAL. OVER 4,000 IN USE. COMPRISING OVER 3,600 H. P.

Burns Screenings, Slack, Wet Sawdust, Wet Hops and all Kinds of Refuse Fuel with Large Economy.

WE ARE PREPARED TO FURNISH COMPLETE OUTFITS OF MOTIVE POWER FOR ELECTRIC LIGHT AND POWER STATIONS

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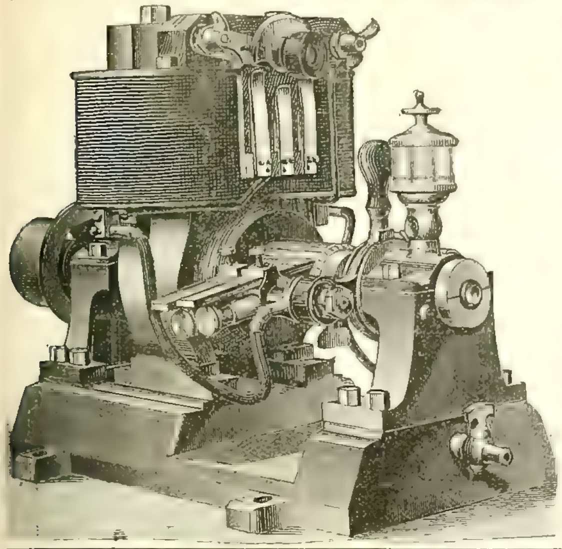

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MANUFACTURERS OF

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Never Blacken, and a Long Life is

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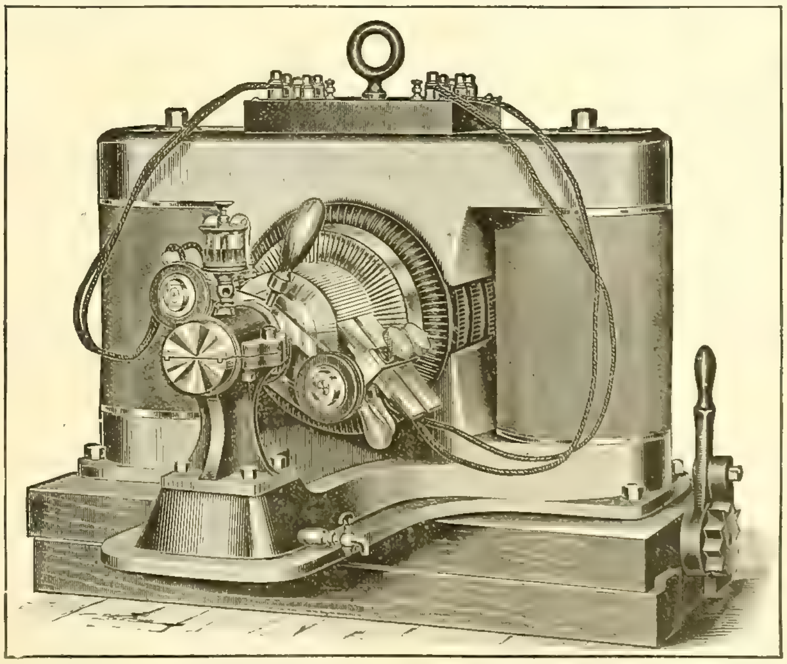

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MACHINERY SIMPLICITY ITSELF.

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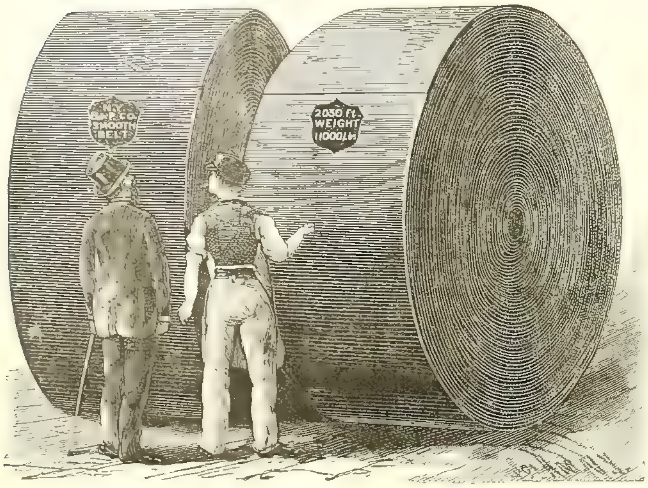

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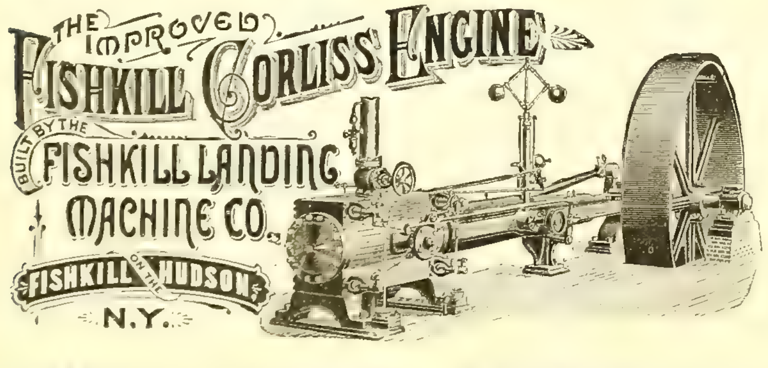

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Recent Improvements in the Construction of these ENGINES place them decidedly in the lead as an engine specially adapted to

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An Examination will satisfy anyone of this.

THE BEST OF MATERIALS

Only are used in their construction, resulting in great DURABILITY, while the "cut-off" device insures the most ECONOMICAL use of fuel yet accomplished.

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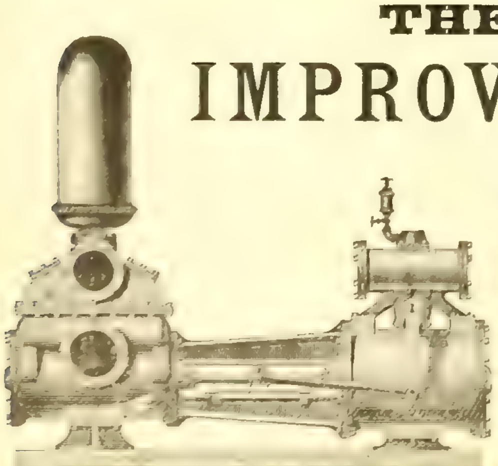

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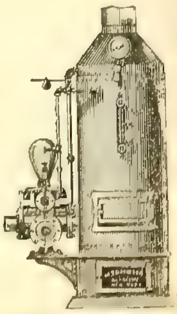

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COMPLETE CENTRAL STATION OUTFITS.

Alternating Current Apparatus,

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Electric Motors,

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150 CENTRAL STATIONS IN OPERATION. 150

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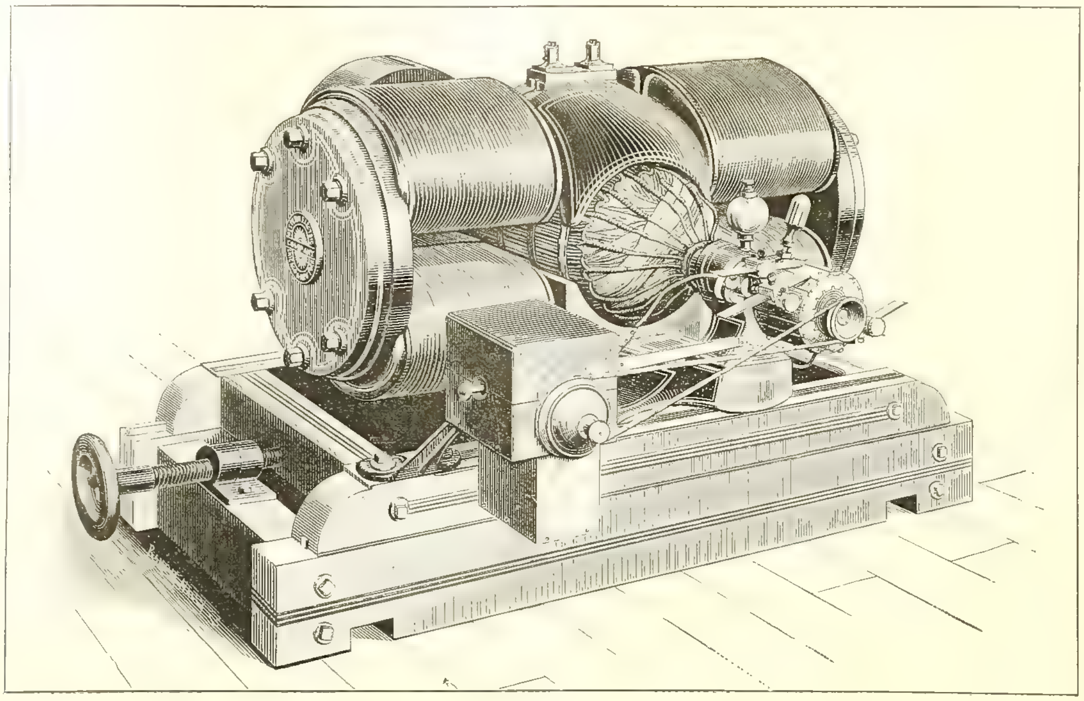

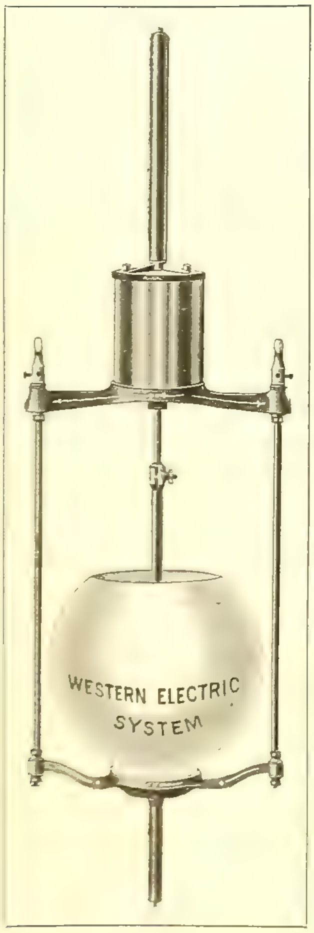

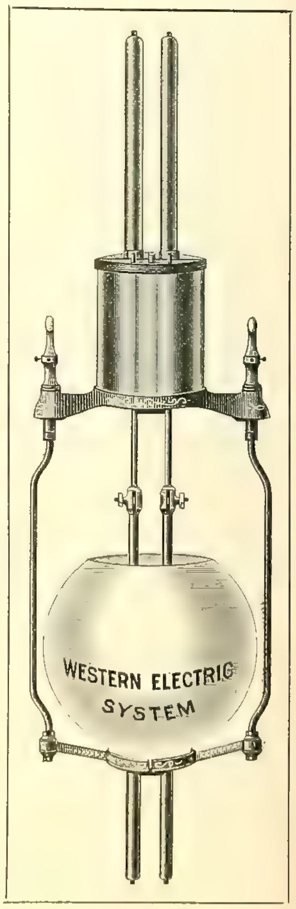

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Arc Lighting.

COMPLETE IN EVERY RESPECT.

PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician

EVERY SATURDAY.

Vol. IV. CHICAGO, FEBRUARY 23, 1889. No. 8

THE CONVENTION

Of The National Electric Light Association at Chicago.

The ninth convention of the National Electric Light association was held in Chicago February 19th, 20th and 21st. From every point of view the meeting was the most successful in the history of the association. The sessions were held in the Exposition building, which in every way was well adapted to the requirements of the association. The assembly room was conveniently arranged, and was beautifully decorated with incandescent globes of various colors. In the art rooms and in the spacious main hall there was abundant space for exhibits of electrical machinery. The following is a list of members and guests who were present:

MEMBERS AND GUESTS.

Andrews, W. S....................Minneapolis, Minn
Alexander, P. H....................New York, N. Y.
Adams, George H....................Hartford, Conn.
Acheson, E. G....................Pittsburgh, Pa.
Abdank-Abakanowicz, B....................Paris, France
Ackerman, P. C....................New York
Ayers, A. D....................Kalamazoo, Mich.
Armour, F. N....................Chicago
Ashton, H. G....................Boston, Mass.
Askew, C. B....................Chicago, Ill.
Austen, G. L....................Boston, Mass.

Burgess, W....................Duluth, Minn.
Beck, Z....................Chicago
Burdette, J. W....................Burlington, Ia.
Brintnall, H L....................East Saginaw, Mich.
Bliss, Samuel E....................Chicago, Ill.
Burns, P. C....................St. Louis
Babcock, S L....................Cuyahoga Falls, O.
Barclay, C. M....................Chicago, Ill.
Barnum, George S....................New Haven, Conn.
Barclay, J. L....................Chicago, Ill.
Blaxter, G H....................Pittsburgh, Pa.
Barton, Enos M....................Chicago, Ill
Beebe, L. A....................Hutchinson, Kan.
Badt, F. B....................Chicago, Ill.
Blades, H. H....................Detroit, Mich.
Barton, S. E....................Boston, Mass.
Botsford, C. R....................New York
Bierce, G. N....................Dayton, O.
Biedler, W. T....................Baltimore, Md.
Bean, W. W....................St. Joseph, Mich.
Brady, T. H....................New Britain, Conn.
Baker, Cyrus O....................Newark, N. J.
Baker, F. J....................Chicago
Barrett, J. P....................Chicago, Ill.
Beetle, George L....................Chicago, Ill.
Brown, C. A....................Chicago, Ill.
Bates, T. E....................Worcester, Mass.
Bass, L. C....................Boston, Mass.
Baggot, E....................Chicago
Baird, M. E....................Windsor, Conn.
Baird, M. J....................Boston
Baker, R....................St. Paul
Barker, G. M....................Chicago
Baugher, F. W....................New York
Belding, W. S....................Chicago
Bennett, J. C....................Chicago
Bines, Robert....................Chicago
Bishop, K. D....................Cleveland
Blackwell, E. D....................Montpelier, Vt.
Bliss, A. E....................Malden, Mass
Bliss, G H....................Chicago
Bosson, F. N....................Chicago
Boulton, W. H....................Cleveland
Bournonville, A....................Philadelphia
Bowen, Wm....................Davenport, Ia.
Branch, Chas. A....................Chicago
Brison, J....................Chicago
Britton, C. S....................Cleveland
Brophy, Capt. W....................Boston
Brownell, H. G....................Chicago
Brukins, H. D....................Chicago
Bullard, C. P....................Bridgeport, Conn.
Burdick, J. R....................Chicago
Burnham, L. W....................Boston
Burns, C A....................Chicago
Burrell, E. L....................New York
Butterworth, F....................Chicago
Ba low, E. J....................Chicago

Bain, [illegible]....................Chicago
Cleverly, H. A....................Philadelphia, Pa.
Candee, Willard L....................New York, N. Y.
Cheney, F. A....................Elmira, N. Y.
Cobb, Henry B....................Wilmington, Del.
Cole, Lafayette....................Peoria, Ill.
Coleman, Robert....................New York
Cox, Samuel E....................Cleveland
Crouse, J. B....................Cleveland, O.
Canny, C. C....................Detroit
Cooper, Charles....................Brooklyn, N. Y.
Chalmers, David....................New York, N. Y.
Connor, W. A....................Pittsburgh, Pa.
Cook, G. W....................Detroit
Chenoweth, A. C....................New York
Chase, M. C....................Chicago
Cherry, E V....................Cincinnati
Conant, T. P....................Chicago
Cone, C. H....................Kansas City
Cutter, George....................Chicago
Cutler, H. H....................Newton, O.
Colvin, F. R....................New York
Conkling, A....................New York
Carson, G. L....................Chicago
Coale, S. H....................Chicago
Cram, H. B....................Boston
Cross, J. H....................Johnstown, N. Y.
Crossman, A....................Chicago
Cullen, W. F....................New York
Curtiss, C. C....................Cleveland
Curtis, L R....................Mendota
Curtis, C. B....................Chicago
Davis, J. H....................Boston
DuShane, Prof. J....................South Bend, Ind.
Dormin, W. J....................Chicopee, Mass.
Duncan, S. A....................Pittsburgh, Pa.
DeCamp, A. J....................Philadelphia, Pa.
Dunderdale, C. F....................Chicago, Ill.
Degenhardt, F. E....................Chicago, Ill.
Daggett, H. M....................Attleboro, Mass.
Dillon, Louis W....................Attleboro, Mass.
Dorsett, H. D....................Chicago, Ill.
Deland, F....................Chicago, Ill.
Davis, W. K....................Boston
Davidson, E. E....................St. Paul
Davidson, J....................Chicago
Dee, J. R....................Houghton, Mich.
Dexter, C. H....................Chicago
Duncan, H. E....................Boston

Ehrhardt, Dr....................Beardstown, Ill.
Ecclesine, J. R....................New York
Edson, Jarvis B....................New York, N. Y.
Ellis, Edwin....................Terre Haute, Ind.
Eustis, H. H....................Boston, Mass.

Fitz-Hatton, H....................Paris, France
Franklin, Wallace....................Grand Rapids, Mich.
Fairbanks, H. H....................Worcester, Mass.
Fitzgerald, W. H....................Detroit, Mich.
Fishback, S. M....................St. Louis
Fox, Edward H....................Brookly
Francisco, M. J....................Rutland, Vt.
Foote, A. R....................Cincinnati, O.
Fisher, Albert....................Chicago
Ferguson, L. A....................Chicago
Fisher, G. E....................Detroit
Fiske, A....................Chicago
Fletcher, J. R....................Dayton, O.
Freeman, W. K....................Eau Claire

Geary, J. R....................New York
Gennert, E. F....................New York
Giles, C. K....................Chicago
Gates, C. W....................Massillon, Ohio
Gerling, Jacob....................Rochester, N. Y.
Garratt, A. V....................New York
Godfrey, J. W....................New York
Gilbert, Fitch....................Eau Claire, Wis.
Gleason, W. C....................Chicago
Gallagher, R. E....................New York
Gilbert, F. A....................Boston
Grasier, H. A....................Chicago
Goehst, J. H....................Chicago
Goodwin, H. D....................Milwaukee
Goodhue, W....................Chicago
Gregory, C. E....................Chicago

Harris, David J....................St. Louis
Heggem, Chas. O....................Massillon, O.
Howard, Wilbur....................Detroit
Harrison, W. J....................New York
Humphrey, H. H....................Buffalo
Hine, Wm. S....................New York
Huntley, C. R....................Buffalo
Hubbard, Wm....................Elgin
Hodges, N. D. C....................New York
Haines, H. M....................New York

Hering, Carl....................New York
[illegible], H. C....................[illegible]
[illegible], [illegible]....................[illegible]
Hatch, E. B....................Hartford, [illegible]
[illegible], [illegible]....................[illegible]
Hammett, William A....................Chicago
Hewlings, A. [illegible]....................Chicago
Hood, Wm....................Chicago
Haskins, C. C....................Chicago
Horne, F. W....................Chicago
Hamlin, C. [illegible]....................Chicago
Hammett, W. A....................Chicago
Harding, H. McL....................New York
Harrington, [illegible] W....................Chicago
Harter, G. A....................Chicago
Hayes, H. [illegible]....................Cleveland
Hearenrich, [illegible]....................[illegible]
Johnson, G. I....................Chicago
Jacobus, Delos....................Crookston, Minn.
Jennings, C. C....................Detroit
Jensen, J. L....................Brooklyn, N. Y.
Judge, John P....................Baltimore
Johnstone, W. H....................New York
Jackson, W. H. H....................New York
Kerr, Walter C....................New York
Kempt, Alex....................Chicago
Kreidler, W. A....................Chicago
Knapp, M. A....................Chicago
Kinney, H. A....................Omaha
Killicutt, D....................Boston
Kinsman, [illegible]....................New York
Kimball, W. R....................Boston
Kammeyer, C....................Eau Claire, Wis.
Kleinsteuber, Paul C....................Milwaukee
Knapp, A. C....................Chicago
Lockwood, J. E....................Detroit
Lucas, John B....................Chicago
Linesman, E. H....................Clinton, Ia.
Law, M. D....................Philadelphia
Lucas, H. P....................Cleveland
Lee, D. W....................Boston
Leonard, H. Ward....................Chicago
Lawrence, W. H....................Cleveland, O.
Leonard, S. S....................Minneapolis, Minn.
Lufkin, H. L....................New York
Latshaw, Z....................New York
Leisering, J. D....................New York
Lyman, W. C....................Chicago
Larbig, Theo....................New York
Lemp, M. J....................Providence, R. I.
Lynch, E. T., jr....................New York
Moses, Otto A. Dr....................New York
Mills, B. F....................Cleveland, O.
May, Edward....................New York
Magee, F. A....................New York
Mason, A. F....................Boston
McKinlock, George....................Chicago
Mayo, George A....................Chicago
McClees, Edward B....................New York
Marsh, Joseph W....................Pittsburgh, Pa.
Meade, Clarence W....................New York
Morrison, J. F....................Baltimore
McQuaide, J. S....................New York
Munroe, W. W....................Chicag
Mori, Alfred....................Paris, France
Meiser, R J....................Cincinnati
Mercein, Thomas R....................Milwaukee
Mason, A. F....................Boston
Moss, Fred....................New York
Manson, George T....................New York
McKinlock, W. H....................Chicago
Marble, George W....................Chicago
Mason, J. H....................Boston
Matterson, C. D....................Chicago
McCarthy, M. H....................Minneapolis, Minn.
McClure, [illegible]....................Cincinnati
McDonald, R. T....................Fort Wayne
McIntire, C....................Newark, N. J.
Meech, Jas F....................Boston
Mendelssohn, L....................Chicago
Miller, [illegible] H....................Chicago
Moore, W. H....................[illegible], N. J.
Manson, C. H....................Chicago
Maher, Edward A....................[illegible], N. Y.
Mead, Morris W....................Pittsburgh
Norcross, P....................Janesville, Wis.
Nichols, George....................[illegible], Wis.
Penn, Jerome....................Washington, D. C.
Price, Chas. W....................New York, N. Y.
Page, C. [illegible]....................[illegible]
Pratt, J. K....................[illegible], Mass.
Pierre, [illegible]....................New York
Petersh, [illegible] A....................[illegible]
Preble, Wm....................Chicago
Preston, [illegible] M....................New York

Preece, W. H. .... Chicago, Ill
[illegible] A. H. .... New York, N. Y.
Pellenger, G. .... Akron, O.
Perry, M. J. .... Providence, R. I.
Phelps, Geo. M. .... New York, N. Y.
[illegible] M. F. .... Detroit
Peck, E. F. .... Brooklyn, N. Y.
Pettengell, F. E. .... Boston, Mass.
Phillips, [illegible] .... Providence, R. I.
Parser, F. W. .... Chicago
[illegible] .... Pittsburgh, Pa
Pope, Henry W. .... Elizabeth, N. J.
Pearson, W. L. .... Chicago
Pond, [illegible] H. .... St. Louis, Mo
Patste, H. I. .... Philadelphia
Pumpelly, J. K. .... Chicago
Parrish, M. W. .... Detroit
Peck, H. B. .... Detroit
Perry, D. P. .... Chicago
Perry, F. L. .... Chicago
Porter, G. T. .... Milwaukee, Wis.
Powers, E. I. .... Chicago
Preston, E. B. .... Chicago
Quimby, W. F. .... Newark, N. J.
Royce, Fred W. .... Washington
Rorison, Brainard .... Indianapolis
Roy, R. F. .... Boston
Rust, R. E. .... Eau Claire, Wis.
Roney, F. B. .... Pittsburgh
Ransom, C. N. .... Boston, Mass.
Raum, Green B. .... Washington
Ross, R. F. .... Boston, Mass
Raichle, F. G. .... Buffalo
Richmond, C. T. .... Cleveland, O.
Reed, Henry A. .... New York, N. Y.
Russell, Chas. M. .... Providence, R. I.
Ryan, R. W. .... New York
Roe, Geo. H. .... San Francisco, Cal.
Ridlon, Frank .... Boston, Mass.
Redman, George A. .... Rochester, N. Y.
Rhodes, B. .... Niagara Falls, N. Y.
Robinson, A. A. .... Detroit
Russell, D. R. .... St. Louis
Richardson, D. W. .... Standish, Mich.
Richart, E. B. .... Cincinnati
Rosenstamn, S. .... New York
Russell, E. M. .... St. Louis
Schultz, J. A. J. .... St. Louis, Mo.
Spaulding, H. C. .... Boston
Schaefer, Fred .... Ft. Wayne, Ind.
Skillman, H. S. .... New York
Schenck, U. H. W. .... New York
Sheldon, W. A. .... New York
Sherwin, D. P. .... Chicago
Smith, J. G., jr. .... Cincinnati
Stafford, E. .... Chicago
Scottford, L. K. .... Chicago
Stevens, N. C. .... Toledo, O.
Spiker, E. L. .... Waterloo, Ia.
Steuart, Arthur .... Baltimore, Md
Sargent, F. A. .... Chicago
Sunny, B. E. .... Chicago, Ill.
Sekell, A. C. .... Grand Rapids, Mich
Sims, G. E. .... Providence, R. I.
Schultz, J. A. J. .... St. Louis, Mo
Smith, T. C. .... Philadelphia, Pa.
Schenck, J. M. .... Lebanon, Pa.
Smith, G. M. .... Chicago
Shane, G. F. .... Pittsburgh, Pa.
Scoville, J. D. .... Cleveland
Sprague, Timothy W. .... Boston, Mass.
Shaw, J. H. .... Chicago
Seiden, Chas. .... New York, N. Y.
Stump, Clarence E. .... New York, N. Y.
Shain, Chas. D. .... Chicago, Ill.
Stanley, H. D. .... Bridgeport, Conn.
Schreren, Charles A. .... New York
Schlegemilch, I. .... Boston, Mass.
Shaw, A. C. .... New York
Shields, J. H. .... Chicago
Simon, S. .... Detroit
Simmons, L. J. .... New York
Smith, G. M. .... Chicago
Sperry, Elmer A. .... Chicago
[illegible] D. E. .... Chicago
Stephens, C. H. .... Chicago
Stiles, A. K. .... Chicago
[illegible] W. A. .... Chicago
[illegible] H. M. .... New York
[illegible] C. H. .... Detroit
Talbot, J. E. .... Ft. Wayne
[illegible] M. .... Chicago
[illegible] H. .... New York
[illegible] M. .... Oakland, Cal.
Thomas, J. M. .... Chicago
[illegible] .... Dayton, O.
[illegible] .... New York
[illegible] .... Detroit
[illegible] .... Chicago, Ill.
[illegible] .... Chicago
[illegible] .... Chicago
[illegible] .... Chicago
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Ward, C. .... [illegible]
[illegible]

Wheeler, G. F. .... Beloit, Wis.
Wiban, George .... Buffalo
Warden, Henry .... Philadelphia
Welkins, E. Ward .... Philadelphia
Wilmerding, C. H. .... Chicago
Wilkins, F. H. .... New York
Wadsworth, G. H. .... Chicago
Warren, C. C. .... Chicago
Watts, H. F. .... Sandusky
Weissleder, L. H. .... Cincinnati
Western, B. R. .... New York
Wheeler, C. J. .... New York
Whitmore, W. G. .... Chicago
Williams, E. F. .... Chicago
Wilson, Charles .... Chicago
Wonham, W. C. .... New York
Wood, E. E. .... Chicago
Worland, W. C. .... New York
Whittingham, G. H. W. .... Baltimore, Md.
Wright, J. J. .... Toronto, Can.
Wentz, A. D. .... Colorado Springs, Col.
Wright, A. J. .... Cleveland
Young, J. G. .... New York

Tuesday's Proceedings.

In calling the convention to order, President Duncan announced that, in the absence of Mayor Roche, the convention would be welcomed to Chicago by City Electrician John P. Barrett, of Chicago.

Mr. Barrett was received with applause as he appeared on the platform, and addressed the convention as follows:

PROF. BARRETT'S WELCOME.

MR. PRESIDENT AND GENTLEMEN OF THE CONVENTION: His honor, Mayor Roche, requested me on yesterday to say to you that, as a subject of vital importance to the city of Chicago was being discussed this morning in Springfield, it was absolutely necessary that he be there, but he hoped to pay his respects to this organization to-morrow, or sometime during the session. He also requested me to extend to you the courtesies of the city, the freedom of the town, but on looking over the great number of my old friends whom I see here this morning, I am satisfied that the city is not large enough to contain all of you, and therefore I include, in your welcome to the city, the parks and the boulevards. If you have any difficulties anywhere, I will leave my telephone number here, boys, so that we will be able to get you out of any trouble into which you may get. I hope to meet you also here tomorrow, when his honor, the mayor, will more fully express our obligations to you. I thank you. [Applause.]

President Duncan, in response, said: We are certainly very much obliged to the authorities of Chicago for the welcome which they have tendered us, but they have evidently mistaken the class of citizens who belong to this association. We will not need any parks to go to in the manner suggested by our friend; I think we can all confine ourselves during business hours to this building, and later we will enjoy the hospitalities of the town. In the name of the association, I heartily thank the authorities of Chicago for the welcome tendered us.

President Duncan delivered the annual address to the convention, as follows:

PRESIDENT DUNCAN'S ADDRESS.

Gentlemen of the National Electric Light Association:

But few of the gentlemen of this country who are commercially connected with the manufacture and distribution of electric light and power, and the apparatus used therefor, are aware that five years ago this month a handful of men met in this city and organized a movement which has grown into the large and powerful organization of which we are members, and which is in session at the present time.

The industry of electric lighting at that time was carried on with all the enthusiasm which comes with a new undertaking, and with the mistakes which are sure to arise in the commercial introduction of any great industrial agency. The gentlemen engaged therein, strangers to one another, working independently, with no attempt at harmony, with but little knowledge of one another's methods of business, with no established custom or precedent to guide them, came together for the purpose of deriving those benefits which invariably result from the deliberate discussion of those mooted questions which are common to the experience of all electric light men.

To even enumerate the topics which have been discussed at the various conventions of this association, the reports which have been rendered by special committees, the papers which have been presented by recognized experts in the [illegible] departments of electrical engineering, and the discussions which have taken place between those well qualified to speak, would consume more time than your president feels at liberty to take for such a purpose from this convention. Fortunately, the association is in possession of a complete set of published proceedings from the first convention down to the present time, and these volumes, [illegible] reporting in the electrical [illegible] this country and abroad, testify to the steady [illegible] of the industry and the increased [illegible] fraternity on [illegible] light and power. It may be [illegible] of [illegible] on the [illegible] electrical fraternity [illegible] then [illegible] The membership [illegible] No sooner [illegible] lighting [illegible] the compounded [illegible] of incandescent light [illegible] the [illegible], and occupied

the meetings of this association. Following closely upon the problems involved in incandescent lighting came the question of electrical distribution of power, first for stationary motor purposes and afterward for the purpose of electrical locomotion. This question is to-day, perhaps, the most important one before the electrical fraternity. To say that electrical power is not to-day a success would be to reflect upon the scores of electrical railways now in successful operation in this country, and upon the thousands of electrical motors that are every day commercially serving the wants of man.

We may here profitably consider some figures indicating the growth of the electric lighting and power industry, the increase in the number of central stations, arc and incandescent lamps, electric motors and electric railways now in operation. At the meeting of this association one year ago, it was estimated that there were not less than 4,000 central station and isolated plants in operation in the United States. From the accompanying statistical table, it may be seen that the number of central station and isolated plants at the August meeting of 1888 was 5,351, and at the present time is 5,747. This shows an increase during the first six months of the year of 1,351 central station and isolated plants, and an increase during the latter half of the year of 716, making a total increase during the year of 2,067 plants. Figuring in percentages, the increase during the first half of the year was 52.3 per cent. in the total number of central station and isolated plants, and during the latter half of the year it was 13.5 per cent., making a total increase for the year of 45.8 per cent. It was estimated a year ago that there were 175,000 arc lamps in daily use in the United States. Six months ago I found upon investigation that there were 192,500. At the present time I find that there are 219,924 making an increase during the first half of the year of 35,201 arc lamps, and during the latter half of the year an increase of 27,424, making a total increase of arc lamps in use during the whole of the year of 62,625. Figured in percentages, the increase the first half of the year shows 20.1 per cent., the second half 14.2 per cent., making a total gain of arc lamps for the year of 34.3 per cent. A year ago it was estimated that there were 1,750,000 incandescent lamps in use in the United States. Six months ago I found that there were 2,142,440. At the present time there are no less than 2,504,490, making a gain during the first half of the year of 392,924, and during the latter half of the year of 361,596, or a total gain for the year of 754,990 incandescent lamps. Figured in per cent., it shows a gain during the first half of the present year of 32.3 per cent.; during the latter half 10.7, a gain during the whole year of 49 per cent.

It is also interesting to notice what the increase in capitalization has been in electric light companies of the United States during the year. During the first half of the year the increase was $42,210,100; during the latter half it was $27,187,634, making a total gain during the year of $69,397,734.

It is also interesting to note some comparative figures upon the electric railway industry. Six months ago, there were 34 electric railroads in operation in the United States. During the last six months there has been an increase of 19, making at the present time a total of 53. Six months ago there were 83 roads in process of construction. There are 39 less at the present time, making the number of roads now under construction not finished, 44. Six months ago there were 39 electric roads incorporated in the United States upon which construction had not yet begun; at the present time there are 42. Six months ago there were 225 electric cars in operation. Since that time 155 have been put into commissions, making, at the present time, 379 cars in operation. Six months ago there were 244 cars under contract but not in operation. This number has increased by 185 during the last six months, making a total of 339 electric cars at present under contract but not running. Six months ago there were 138 miles of single track in operation; during the past six months there has been an increase of 157½ miles, making a total at the present time of 294½ miles of single track in operation. Six months ago there were 189⅛ miles of single track under contract but not in operation. At the present time there are 273¾ miles of single track under contract but not in operation. It would be profitless for me to draw elaborate deductions from these figures; they tell for themselves the story of prosperity and rapid growth throughout every department of the electric light and power industry.

Acting under resolutions passed at the last convention, the president of this association established a headquarters in the city of New York in charge of the secretary and treasurer on the first day of October, 1888, which action was confirmed by the executive committee on Nov. 19. From this office has been carried on a voluminous and elaborate correspondence with the whole lighting and power fraternity of this country, not only upon the subject of the work of the various committees of the association, but also in regard to this most important feature, the exhibition of electric light and power apparatus. For the first time in the history of the National Electric Light association, this has received the prominence which it merits. The exhibit which appears in the other rooms of this building testifies not only to the interest which is shown by the electric lighting and power men of this country in the apparatus which is now before the market, but it also shows the fact that the manufacturers and dealers in apparatus and supplies are willing to put themselves to expense and trouble to bring their wares to our notice in a suitable and proper way, when we are gathered at our meetings. Although this movement originated prior to the last convention and the correspondence pertaining thereto has been carried on by the New York office, I wish to say that much of its success is due to the admirable and methodical management of the chairman of the executive committee, Mr. B. J. Sunny, of Chicago. We are gathered at the present time, gentlemen, not only for the purpose of seeing an exhibit of the latest forms of electrical apparatus and supplies, but primarily for the purpose of listening to papers and

discussions upon all important electrical questions I will not burden you with a detailed account of these reports and papers and discussions which will come before this body. Some of the subjects deserve special mention. Petroleum for fuel first received attention from this body at its last meeting. At this present meeting several papers will be presented upon this all important subject The question of the materials of underground conduits in relation to the insulating materials of cables will also be treated. The mooted question of static charge on underground cables and the attendant puncturing thereof will also be the theme of an elaborate paper Electric light stations as fire risks will be comprehensively treated by a recognized expert in fire underwriting who has given especial time and attention to this particular branch of the subject. The question of municipal lighting, which is pressing upon the electrical fraternity to-day, will be the subject of one or two papers and no doubt of a profitable discussion. The numerous committees of this association have reports to make upon subjects which will be of much interest to all. The committee on underground conduits and conductors has carried on an enormous correspondence with the entire electric lighting fraternity of this country, and it seems eminently proper that the information they have gathered should be presented in this city of Chicago where the subject of the undergrounding of electric lighting wires has been more practically carried out than perhaps in any other city in the world. This question, which is at present one in which diverse opinions are held by men of equal professional standing, is one which this association cannot afford at the present time to ignore or overlook.

This association is at the present time in a flourishing financial condition. By this we do not mean that we are rolling in wealth, but that we are comfortably able to pay our bills. Since our last meeting the entire membership roll has gone through a revision, the memberships at the present time being vested in individual names instead of corporations. This has, of course, involved an enormous amount of correspondence and a vast outlay of time and trouble. It has, however been successfully accomplished and at the present time the roll of live, new members testifies to the wisdom of this action. Although the association numbers among its members every gentleman actively interested in the electrical distribution of light and power, it is an undisputed fact that it should contain not less than three times that number. It is believed that the association is now on that "tide in the affairs of men which leads on to fortune." With the proper exercise of care in the management of the association, it is felt that the enormous growth of the industry and the consequent influx of hundreds of men into its ranks will lead to a much greater increase in the roll than there has ever been before. The gain of new members since Jan. 3 evinces the fact that an interest is being taken in the association by the community at large.

During the call of the roll the chair announced that gentlemen having proxies must produce them to the secretary.

MR. MORRISON: I move that, during the session of this convention, from now until its final adjournment, twenty-five members be considered a quorum for the transaction of business.

The motion was unanimously adopted.

THE PRESIDENT: Can the secretary state the number of gentlemen present? About how many? The chair's recollection is there were about eighty present who answered the roll call. There is a quorum present for the transaction of business under the resolution you have just adopted.

DR. MOSES of New York: You have called attention to one of the deficiencies in our constitution. We have had occasion recently to examine into its efficacy as covering certain matters brought before the executive committee. We find that it has been rather loosely constructed. It is a very important thing that this association should have a good constitution, and one that is not likely to be altered at each session. I would therefore move that a committee be appointed by the chair for the purpose of revising our constitution and by-laws, and that they be ordered to submit a draft of the constitution and by-laws to be presented at the next regular meeting of the association, and that that committee consist of three members

The motion was amended by making the committee consist of five instead of three. The motion was unanimously adopted, and the chair announced that he would name the committee later on.

GEORGE M. PHELPS of New York: In regard to the matter under consideration, I would move that, as soon as possible, we proceed to the selection of a nominating committee, who shall nominate officers for the ensuing year, and also select a place and time for the semi-annual meeting.

A motion to appoint a nominating committee was tabled until the following day.

Allan V. Garratt then read his report, as secretary, as follows:

SECRETARY'S REPORT.

Total number of members on previous record	189
Number of old members who have resigned or do not reply	76
Leaving of the old membership now in good standing	113
New members added since January 3	62
Making membership paid upon on February 18, 1888.	175
The treasurer also has letters requesting their names to be placed on roster, but not accompanied with checks	23
According to the constitutional provision therefor, the names of the twenty-three gentlemen cannot be added to the books, though they would swell the roll to	198

It was moved that the secretary's report be accepted and placed on file. It was referred to the executive committee.

Mr. Garratt read his report as treasurer as follows:

The last treasurer's report rendered to the association shows a balance of $1,935 23. This has not been re[illegible] by the present treasurer and the present [illegible] with no [illegible]. The receipts and disbursements [illegible] Nov. 2[illegible], 1888, and Feb. 1[illegible], 1889, are $[illegible], expenditures, $[illegible] cash on hand, $3,011 92

There are bills outstanding against the [illegible] authorized by the treasurer under [illegible] of the executive committee, when paid from the [illegible] in the hands of the treasurer there will be a balance on hand of $2,[illegible].

The report was referred to the executive committee.

THE PRESIDENT: The next business in order would naturally be the report of the executive committee.

B. E. SUNNY of Chicago: The executive committee is not prepared to report and will respectively ask for further time.

THE PRESIDENT: The executive committee is not prepared to report and if there is no objection further time will be granted for the presentation of the report The next in order is reports of special committees. The first which I have on the list is the report of the committee on patent legislation by Mr. Steuart of Baltimore.

ARTHUR STEUART: I have only to make a report to you of what has been done during the past six months, and to state that we have accomplished something in the direction in which we have been striving, but we have not done all that we hoped to do, but we feel that we are in a position to carry on this work with success in the near future. At the last meeting of this association held in New York, I had the honor to report to you that the bill which we had introduced in congress was pending before the judiciary committee and that I had reason to expect that the committee would make a favorable report on our bill and recommend its passage by congress. Since that time they have made a report, and I will read the report which they have made.

REPORT OF COMMITTEE ON PATENT LEGISLATION.

The committee on the judiciary, to whom was referred the bill (H. R. 9084) to establish a court of patent appeals, have considered the same, and report it to the House and recommend its passage, with amendments herewith submitted.

The court of patent appeals as provided for by the bill and amendments reported by the committee, consists of one chief justice and two associate justices, who shall be appointed by the President, by and with the advice and consent of the Senate, and who shall hold office during good behavior, and receive a salary each of $6,000 per annum.

The associate justices shall take precedence according to the dates of their commission, or, when the date of the commissions may be the same, according to age.

The bill provides for the appointment of a clerk, deputy clerks, marshal and reporter by the court. The fees of the clerk shall be the same as now allowed by law to the clerk of the Supreme court, but shall not exceed $6,000 a year. The salary of the marshal is fixed at $2,000 per annum

The pay of the reporter is not to exceed $2,500 annually, unless the number of reports required to be printed shall be increased by order of the court, in which case the salary or pay may be increased, not exceeding $1,500 a year.

The court is required to hold one term annually at the seat of government, commencing on the second Monday in October, and may hold special or adjourned terms as the court may deem proper for the dispatch of business

The jurisdiction of the court as prescribed and defined in the bill is as follows:

SEC. 14. The court of patent appeals of the United States shall have appellate jurisdiction in the cases hereafter specially provided for without regard to the sum in controversy.

1st. "From the courts of the United States having original jurisdiction of cases touching patents, copyrights, trademarks and labels, in all cases involving these subjects."

2d. From the commissioner of patents in all cases touching the patentability of inventions, priority of invention among several claimants for patents upon the same invention, and in all cases of re-issue and the judicial practice of the patent office, also all cases touching the registration of trademarks and labels and the rights of conflicting claimants therefor.

SEC. 15. From and after the passage of this act there shall be no appeal from the circuit courts of the United States or any territorial or district court or court of the District of Columbia, in cases touching patents, trademarks, copyrights or labels to the Supreme court of the United States directly, but all such cases formerly appealable to the Supreme court shall be heard on appeal by the court of Patent Appeals.

SEC. 16. There shall be a right of appeal from the court of Patent Appeals to the Supreme court of the United States in all cases regardless of the amount in controversy; subject to the same regulations, however, as now exist with regard to appeals to the Supreme court in causes of admiralty and maritime jurisdiction and to such further regulations as the Supreme court of the United States may make.

SEC. 17. All cases touching patents, trademarks, copyrights, or labels now pending before the Supreme court of the United States awaiting trial shall be transferred to and heard by the court of Patent Appeals.

The expediency and propriety of, if not necessity for the the establishment of, such a court as contemplated by this measure will not be questioned if proper consideration be given to the objects that will be attained by the passage of this bill

Among the results reasonably expected to flow from the organization of the court of patent appeals, attention may be called to the following:

(1) It would enable the public and patentees to determine the value and validity of patents without serious and vexatious delays, and thus promote the interests of all concerned.

(2) It will relieve the Supreme court of much of the burden imposed upon it by this class of litigation.

(3) The practice in the patent office would become thor[illegible]

[illegible]

money are required.

When ordinarily the financial life of a patent is abridged by the difficulties of placing the invention into general use, we can appreciate the importance of speedy decisions when it is infringed or when its validity is questioned.

Under the present condition of the business of the courts it requires, ordinarily, from two to three years to obtain a decision in the circuit courts of the United States, and if appealed to the Supreme court, from three to four years are required to obtain a decision then. It may be said that the same difficulty and delay attend the determination of all other questions involving the determination of property rights. While this is true, it should be borne in mind that this species or character of property differs from all other kinds of property. The duration of the owner's title is arbitrarily fixed by law. The period is short, for the most part seventeen years.

The constitution imposes upon Congress the duty of securing to authors and inventors, for a limited time, the exclusive right to their respective writings and inventions. It is submitted, respectfully, that this duty is very imperfectly discharged when, by the omission of Congress to provide proper means to determine questions arising out of patents, the life of a patent may be frittered away by the delays of the law.

As has been said, it requires from three to four years after a cause has been filed in the Supreme court to obtain a decision. This does not result from any fault of the judges. It is due solely to the fact that Congress has so broadened the appellate jurisdiction of the court as to overburden the physical capacity of the tribunal.

The original jurisdiction of the court, fortunately, is fixed by the constitution, and Congress cannot add to it or subtract from it; but the appellate jurisdiction of the court is subject to the power of Congress, and that authority has been exercised without proper regard to the physical capacity of the judges or the interests of litigants.

This condition ought not to be continued It operates in a great many cases as a denial of justice, and every citizen of the United States is interested in bringing about a change.

It may be asked how this measure will contribute to the result? To that inquiry it may be answered that, by the sixteenth section of the bill, as quoted herein, it is provided that appeals from the court proposed to be established to the Supreme court shall be subject to the same regulations as now exist with regard to appeals to the Supreme court in cases of admiralty and maritime jurisdiction, and to such further regulations as the Supreme court may make.

By reference to the act of 1875, relating to the practice in the courts of the United States in cases of admiralty upon appeals to the Supreme court, and the rule of the Supreme court upon that subject, it will be observed that the circuit court is required to make a finding of facts and law, and the review of the judgments of the circuit courts by the Supreme court in these cases is confined to questions of law only.

It follows that if a similar rule shall be applied to patent cases as the sixteenth section of the act provides, the Supreme court in reviewing the judgments of the court proposed to be established will pass upon questions of law only, and thus from fifteen to twenty per cent. of the time now consumed by the court in these cases in wading through voluminous records, endeavoring to find the facts, will be saved and profitably applied to the disposition of other business in the court.

It is difficult to perceive any good reason for requiring the Supreme court to find the facts in patent cases and not in admiralty cases

Upon the score of economy, it is respectfully submitted that the expenses of this court will not exceed $[illegible] per annum.

Such a sum of money bears no comparison to the amount that will be saved to the people of the United States by the speedy adjudication of questions arising out of patents. To this should be added, also, the incalculable advantage that will result to litigants in the Supreme court of the United States from the saving of time.

The income of the patent office for the fiscal year ending June 30, 1888, was $1,122 [illegible], expenses, $953,[illegible] leaving a surplus turned into the treasury of the United States of $1[illegible],2[illegible]4 40, which, added to the previously credited surplus, makes a balance in the treasury to the credit of the patent fund of $3,337,[illegible] 65.

After reading the report, Mr. Steuart made the following remarks:

At the last meeting of the association, I read in your hearing letters of recommendation which I had received from the members of the Supreme court of the United States, recommending the passage of this bill and the establishment of this court. I have in my hand a letter from the secretary of the president of the United States in

which he says that he has given the matter very careful consideration and is deeply interested in the establishment of a court of patent appeals. I also have here a quotation from the President's message of December 3, 1888, in which he says:

"The crowded condition of the calendar of the Supreme court of the United States, and the delay to suitors and denial of justice resulting therefrom, has been strongly urged upon the attention of the Congress with a plan for the relief of the situation approved by those well able to judge of its merits."

I have, finally, a letter in my hand from the chairman of the judiciary committee who made this report and who has our bill in charge, and who is doing everything possible to have it pass. Together with the chairman, I have moved all the powers that were at my command during the past six months to secure a time for the consideration of our bill. There is no opposition to it whatever. It is very favorably considered by everybody. It is indorsed by all the highest authorities. There is no reason why it should not be passed, except that the calendar of the house is so overcrowded with other bills and the time of the house is so occupied with political matters that nothing of a private nature can be expected to be acted upon. I have here a letter from Judge Culbertson, in which he says: "The committee on rules did not consider favorably the proposition to give the committee on the judiciary time for the consideration of our bill for a court of patent appeals. That being the case, the committee on rules has entire control of what bills shall be considered, and unless they give the time for the consideration no bill can get place before the house."

It is simply buried under an enormous mass of other matter. But the bill is in shape for introduction into the next Congress, and everything is ready for us to begin work again in November, with every reason to expect that we will succeed. We began to consider this matter at the early part of the present fiftieth Congress. It took six months to get the bill into such form as we could all agree upon. It was filed in April. It took me until the first of September or latter part of Augtst to get this report from the judiciary committee favoring the bill and recommending its passage. Since then you have heard its fate; it has lain with thousands of other bills

The report was ordered filed.

THE PRESIDENT: You have heard the recommendation of the chairman of the committee on patent legislation. He has worked without reward, and he makes the statement that he is in arrears to the attorney whom he engaged to assist him in the prosecution of his work. While the association cannot act as a body to liquidate that indebtedness, yet it can be liquidated by the individual members. You understand the question. The chairman of the committee simply requests that voluntary subscriptions be given for that particular purpose.

Secretary Garratt presented the following report of the committee on transportation, in the absence of the chairman of the committee, George F. Porter:

REPORT OF COMMITTEE ON TRANSPORTATION.

Your committee on transportation has to report the completion of its duties, and would state that it obtained favorable rates, viz.: One and one-third fare for round trip from all principal points in the territory east of Chicago, Peoria, St. Louis and Mississippi river. Owing to the association west of these points being considerably disorganized at the time of our filing application for rates we were unable to accomplish anything, unless we would guarantee a minimum of one hundred delegates from that territory.

THE PRESIDENT: The next committee to report will be the committee on insulation of wires and installation of plants. The convention in New York did not appoint any chairman, but allowed the committee to select its own chairman, and the executive committee afterward instructed the secretary at that meeting to call a meeting of this committee and allow it to choose its own chairman and proceed to work. That I understand was done, but the committee has never met. Dr. Moses is the senior member.

MR. MORRISON: The duties of that committee are of such a character that no one engaged in the electric lighting business would care to attempt to fulfill them. It practically involves a decision as to whose wire carries the best insulation. We have carried upon our committee lists for several years this committee on insulation, and we have never yet had a report from them. Prof. Barker, Mr. Henry, Prof. Houston and a large number of scientific gentlemen were assigned to this duty at one time, and [illegible] would get from them a report, [illegible] owing to the inability of the association to provide the scientific instruments for the tests [illegible] to determine certain qualities of insulation [illegible] notably, the lack of an appropriation [illegible] at the disposal of these gentlemen [illegible] they could not operate to any [illegible] a report, except a [illegible] among the archives of the association. [illegible] of things before us, [illegible] up your committee [illegible] some other committee [illegible] that the committee be [illegible]

[illegible]

[illegible]

is, since they have done the work for us, we had better not ask anything more of the community if we have such able exponents of our views. I ask that the committee be discharged

Mr. Morrison moved that the report be accepted and the committee be discharged, and the motion was carried unanimously.

MR. PRESIDENT: It was suggested at the opening of this session to day that the session be a short one devoted to reports of committees, and the chair has called over simply the names of those committees that could report this morning. If there is nothing further before the house, the chair is ready to entertain a motion to adjourn until to-morrow morning after some announcements shall have been made.

THE PRESIDENT: Before we adjourn the chair desires to state that he has appointed as a committee on revision of the constitution, Dr Moses of New York, A. J. De Camp of Philadelphia, Mr. Perry of Providence, Henry D. Stanley of Bridgeport, and Mr Candee of New York.

On motion of Mr. DeCamp the convention adjourned till Wednesday morning at 10 30 o'clock.

Wednesday's Proceedings.

President Duncan called the convention to order Wednesday morning at 11 o'clock.

PRESENTATION TO PRESIDENT DUNCAN.

DR. OTTO A. MOSES, of New York: Mr President, it is a very agreeable feeling to us all, no doubt, to hear the slight rap of those knuckles to bring this large body to order. It shows the respect that we have for law and order. Nevertheless, in the course of debate occasions may arise where it becomes essential to make one's self heard and felt. The usual instrument by which that is done is something more durable than a pair of knuckles. I see that our president has no gavel. I noticed it yesterday, and some of his friends and the friends of this association in the city, thinking of it yesterday, had prepared an insignia of office, and the Central Electric company of Chicago, which represents the Okonite cable, on the spur of the moment had this implement constructed, and a formidable one it is. It is short, but it combines in it a great many things It is a bit of cable which will here remain upon this desk, and will include in its circuit all of our members. At the last meeting in New York, we had occasion to tender our respects and to leave a memento of our affection in the hands of our retiring president. It is a pity that a closed circuit should at any time be interrupted. The general practice in America has been to operate altogether on closed circuits, and for that reason I proposed, and these gentlemen have carried out the idea beautifully, that this should be, as it were, a continuation of that harmonious condition that has existed always throughout this convention. The president may do with this gavel as he pleases.

THE PRESIDENT: I certainly thank you for this emblem of authority. I have no doubt that entire harmony will prevail in this meeting of the association. I have no doubt that the chair will have very little, if any, occasion to use it except in the ordinary tap to call you to order. I know these gentlemen so well, and they will have such a deference for each other's opinion, and the expressions thereof, and will be so courteous in debate that I realize the fact that it will be of very little use so far as you gentlemen are concerned. I appreciate the kindly expression of feeling with which it was tendered, and hope that the circuit will always remain closed.

Eugene T. Lynch read the report of the committee on underground conduits and wires, as follows:

REPORT OF COMMITTEE ON UNDERGROUND CONDUITS AND CONDUCTORS.

GENTLEMEN OF THE ELECTRIC LIGHT CONVENTION: At the eighth meeting of the National Electric Light association, held in New York on August 29th, 30th and 31st, the following resolution was offered and adopted:

RESOLVED: That a committee of five be appointed by the chair to examine into and report upon the system of underground conduits, with underground conductors and conduits now in operation, and the number of wires actually in use in these conduits, and to report at the next meeting of this association.

The president appointed Messrs. Lynch, Barney, Kerr, Davis and Crocker as members of that committee. And as chairman of that committee, I beg leave to submit to the convention the following report:

As the resolution called for a compilation of all data connected with the actual placing of electrical wires underground, your committee deemed it advisable to send out a circular, calling upon and asking all the local electric light companies for the results of any practical tests that they had made

To carry out this idea, they caused to be printed the following circular:

"*From the Committee on Underground Conduits and Conductors.*

"GENTLEMEN: A committee was appointed at the semi-annual convention of the National Electric Light association, held in New York August 29th, 30th and 31st, to investigate and collect all data relating to underground wires and conductors, both in this country and Europe. It is the intention of this committee to present this report at the [illegible] convention of the association which will be held on February 19, 20 and 21, 1889.

"As many [illegible] statements have been made, from [illegible] experiments or tests with underground wires, [illegible] the committee (in order that it may [illegible]) feels that it is necessary to [illegible] and facts regarding [illegible]

"[illegible] as far as may be [illegible] and return the same [illegible] as promptly as possible [illegible] upon as

confidential, and will not be referred to by name or locality in the report, of the committee. It is desirable that you send in your answers at once, as the compilation of statistics takes time.

"Yours very truly,
"EUGENE T. LYNCH,
Chairman.
"ALLAN V. GARRATT,
Secretary."

1. Have you ever placed underground, any electric light conductors, carrying currents at a potential of 1,000 volts or over? 2. If so, state the number of experiments, giving the date of each. 3. What was the length of each individual conductor laid underground? 4. What was the voltage on each conductor? 5. What was the current, in amperes, carried by each conductor? 6. What make and style of dynamo supplied the current on each of these conductors? 7. Were these conductors single or grouped in cables? 8 How many conductors to the cable? 9. What was the size of the conductors used? (In answering this question give the number and gauge.) 10. What was the thickness of the insulation? 11. Who was the maker of the cable? 12. Were the cables laid in any form of conduit? 13. If so, what kind of conduit was used? 14. Describe the manner in which the cables were laid in the conduit—whether drawn in, built in, or otherwise. 15. If the cables were laid directly in the ground, describe the method of laying them. 16. Was there more than one duct in the conduit? 17. If there were other ducts, what was in them? 18. Did you have exclusive control of the conduit? 19. What was the total duration of your experiments? 20. Did the cables work satisfactorily during the entire time of your experiments? 21. If not, how long did they work satisfactorily? 22. If the cables failed to work satisfactorily, to which of the following causes do you attribute the difficulty? Please answer as fully as possible: a Defective insulation; b. Defects in joints; c. Defects in making connections from cables to lamps.

These were sent to all of the local electric light companies, and in response to them we have received 130 answers. In presenting and compiling the answers to the various questions that were sent out, we have deemed it advisable to divide them into two classes, as follows: Those who have had actual experience in placing and running underground electric wires and those who have not had actual experience, but whose opinions we have asked. Of the former class there are but seven. We will here give the details of the placing of the wires underground, the duration of tests, style of conduit used, and the general results, that were received in each of these seven answers.

As it was stated in the circular sent out that all the communications would be regarded as strictly confidential, we have deemed it advisable that the names of the companies or individuals should not be mentioned in this report; consequently we will not refer to them by name.

First. The writer has used the underground conductors for three years. Has used wire of three of the most prominent manufacturers. Has discarded two and is now using the third The cables were carried in a cement pipe and manholes were placed at every 250 feet. Cables had been drawn into the conduits, and as a method of facilitating their drawing in, pulverized soapstone had been used for the purpose of avoiding abrasion.

Only one wire placed in each pipe. He states that the wires have not worked satisfactorily, and that he has been compelled to shut down many times, that they are now running fairly well, but he is obliged to keep them under constant supervision and repair. He accounts for most of the trouble that he has experienced by defective insulation, defective mechanical construction, and by deterioration in the insulation in the wires, having had no serious trouble with the style of conduits that he has used. In answer to the twenty seventh question regarding the practicability of placing his conductors underground, he states: "We are operating some eight miles of underground wire; we wish there were less, and certainly are not anxious for more." In answer to the twenty-eighth question, regarding the difficulties and objections to underground wiring, and whether he considered them commercial, electrical or mechanical, he states: Electrical.—There is no cable that will last with a current from a fifty-light dynamo. Commercial —Owing to the large cost of construction and expense of maintenance, and great possibility of breaks, there is consequently poor service and dissatisfaction. He has exclusive control of his conduit. The writer has made many experiments in which he has used lengths of cable varying from 200 feet to two miles in length, manufactured by most of the prominent wiring companies. Cables have been laid in and drawn in, in his own conduits, conduits constructed of both wood and iron. The tests have usually been of short duration, and have been suspended in each case after a failure of the cable to work satisfactorily. The cause of the failure has been, mainly, defective insulation. Defective mechanical construction, defects in laying, defective conduits, injury to cables in laying, or defective joints, have caused very little trouble, the main cause of trouble being in defective insulation, and deterioration owing to the presence of gas, water and steam.

His opinions based upon the results brought out by the many tests that he has made is that "he does not consider it practical at the present time to place conductors underground, the absence of insulation that would stand being the principal reason. If ever the question is settled, the cost would, in his estimation, make it commercially impracticable In only one instance he had the exclusive control of the conduit.

Third: The company represented by the writer had four circuits underground for about one year. One style of cable only, manufactured by a prominent manufacturer, was alone used. The wire was drawn into a composition conduit, which had manholes at the corners.

Quite an amount of trouble was caused in the start off, by difficulty caused by abrasion to cable in drawing the wire into the conduit The experiments were continued for one year. They caused a great deal of trouble within the lighting contract, and at the end of that time were

abandoned. He considers his chief troubles to be defective conduits, water in the conduits, and deterioration of the cable, also trouble in defective insulation, defects in the joints, and trouble in making connections through iron pipes from the conduit to the surface.

His opinion based upon the results of the tests that has made is that he does not consider it practicable to place his wires underground, and states "I don't know of any system that has yet proved satisfactory;" and further states: "I know of no system to day which, even at any expense, has proved satisfactory, except a system of subways built large enough for men to walk through their entire length."

In answer to the difficulties of placing wires underground he states that he considers the difficulties to be commercial, electrical and mechanical perfection, and still not be so expensive (in the end) as to make the commercial objection insurmountable.

We are all in the business simply to make money, and the commercial objection must be met just as much as any other. He did not have exclusive control of the conduit.

The ordinance passed by the common council in his city in 1886 stated "that their committee had examined the subject and found the putting of all electrical wires underground feasible, and ordered all wires within a few months, and those outside of this district, underground within one year." He has been brought before the court a number of times on complaint of the city attorney, but nothing yet has been done in the matter.

Fourth: The writer has made two experiments during the last summer, one of which was a failure, and the other a partial success, though the duration of the second test and the position it occupied in the circuit was such as to give little importance to the result. The wires were pulled into a wooden conduit, there being two ducts in each conduit. Cables did not work satisfactorily. He states that the failure is due entirely to defective insulation.

In answer to the question if he considers it practicable to place his conductors underground, he replies, "We do not, with any system known at present."

In answer to the last question, concerning the difficulties and objections to placing wires underground, he states: "The difficulty is particularly commercial, though I have seen no system which I think will properly insulate the conductors."

Fifth: The writer has placed two circuits underground about the first of the present year. The cables used are those manufactured by six of the most prominent companies. They have been drawn into an asphalt conduit, 12 ducts in each conduit. The duration of his experiment has only been about a month and a half, and he states that it is too early to tell what will be considered the result of the experiment.

In answer to the question if it would be considered practicable to place the wires underground, he states, "Have seen nothing yet that will answer."

In answer to the question regarding his opinion regarding difficulties and objections to going underground, he replies, "Chiefly commercial, partly electrical, and partly mechanical." He has exclusive control over his own style of conduit.

The writer has had wires in the conduits for about five years. The mains were carried through the streets in a composite system of conduits, the connections are made from the system to the cellars through iron pipes, and the wires are conveyed then through cellars, connection being made from the cellars to the houses. The cellars run completely around the block and permit of free access to them for the purpose of repairing or making connections to wires.

He has used three different kinds of wires in the conduits, the cables now in use having been in position for about thirteen months; although he has had trouble with them, he claims that satisfactory service can be maintained in his particular locality, as he considers the question of the distribution of power and light an exceedingly simple one in his city, which is probably the only city which is so fortunately situated.

He has in all about thirty-two circuits. He states that he is on the right track regarding the placing of wires underground, and that the system such as he operates will run satisfactorily. The cables that he is using are guaranteed for three years. The trouble that he had with his first wires was mainly due, as far as he can ascertain, to the fact that the insulation surrounding the wires was not of sufficient thickness, and the main conduits themselves were not dry. He controls his own conduits exclusively.

The writer has made some practical experiments and tests with cables under water; these were manufactured by two of the most prominent companies. The cables did not, however, work satisfactorily, lasting, as they did, from three months to one and a half years. He lays the cause of failure to the effect of water upon the cable, and the deterioration in the insulation of the wire. His opinion, based upon the tests he has made, is that he does not consider it practicable to place his conductors underground; considers that the difficulties are both electrical, mechanical and commercial; had exclusive control over such conduits as he used.

In summarizing the results of the experiments in these cities, in one case only did the electric light company place its wires underground willingly; in all others they were forced to do so by the local authorities.

In only one instance have the experiments or practical workings proved satisfactory; the only other case that they did not report adversely being where the wires had only been in operation about forty days. The average voltage that we used on all the circuits tested was 1,893 volts; the current was ten amperes, the average thickness of insulation over wires was 9/32 of an inch, and the average length of cables tested in each case was about 4,600 feet.

In considering the second class of answers, namely, those who have not yet made any extended practical test, their answers have been directed mainly to the last four questions, the first two of which relate to action by the municipal authorities, and the last two consider the practicability and the difficulties of placing wires underground.

In very few of these cities have the municipal authorities yet taken any steps toward action upon the matter, having been delayed in awaiting the solution of the underground question in other cities.

In answer to the 27th question, asking them if they considered it practical to place their conductors underground, 104 have replied that their opinions, based upon tests that they have seen and such information as they have been able to obtain, both in this country and abroad, is "that it has not been practical to place the wires conveying high tension elecric arc light current underground."

Two have answered that they considered it practical to do so, but state that at the present time they have no wires underground.

In answer to the 28th question, which asks their opinion regarding the greatest difficulties to be met with in considering the placing and operating of underground wires, they all unite in the opinion that the difficulties are both mechanical, electrical and commercial.

They consider that the question of obtaining a satisfactory conduit has not been properly solved, and that even if that should be solved in the future we cannot even at this time obtain a satisfactory insulation for the wires that will not deteriorate within a few years, and become perfectly useless as an insulator when subjected to the action of steam, water and gas. The great difficulty of making connections for buildings and lamps, and the absence of any satisfactory system of subsidiary conduits, is considered by all as a bar to successful operation, as the difficulty of drawing in cables without abrasion to the insulating covering, even with the most careful handling, is very great.

The commercial objection is considered a very great one, as not only is the first cost about eight times heavier than that of an overhead system, but the repairs to the cables due to the deterioration of the insulation and other defects caused by mechanical or electrical deficiencies would be very much heavier than the expense of operating and maintaining overhead systems, and that the prices at which they are now furnishing the electric light would have to be very materially increased to meet these extra and very heavy expenses. A system of tunnels through all the principal streets is considered to afford the only means for the solution of this problem.

There are many other responses to the circulars, in which the writers state that they have had no experience with underground lines, and have not yet considered the question in the light that we have placed it before them.

The committee also sent a letter asking many of the questions that were sent in the circular, to all of the electric underground wire companies, and in response received quite a number of communications from the cable companies. Most of them said that at the present time they were unable to give any information in regard to underground wiring, as they have had very little experience with wires for that purpose, but that they do not doubt that in the future the state of the art will permit of the wires being placed underground, and that their particular company will be well equipped for doing so.

Other companies reply that the wiring of their system that has been used for underground purposes has been for potentials under 2,000 volts, and that they have met with entire success with potentials of a system with 1,000 volts. And they do not anticipate in the future that they will have any trouble in furnishing wire to meet the requirements of the electric lighting companies, but at the present time they have not yet done so.

They unite in stating that they think that the question of the insulation of high voltage of currents should be solved by the using of good, durable, thick insulation.

Their experience in conduits has been, that they do not want creosoted wood, but would prefer to have their wires buried in the ground or under water, and would recommend at the present time that single conductors should be used.

They seem to be about evenly divided on the question as to whether lead-covered cables should be used for underground purposes.

The report was accepted and placed on file.

MR. BARRETT: If this convention is in condition to receive information in regard to underground conduits, I will be glad to offer it. I want to say, for the benefit of this convention, that we have had underground service here for the last thirteen years. We have been using electric lights with underground circuits for the last six years. The municiplity purposes to extend its electric light system indefinitely so far as the limits of Chicago are concerned. I hoped that I should receive some information from other communities. When I see in this convention gentlemen who are prepared to guarantee to construct and maintain conduits in any form that you require, and right alongside of them gentlemen prepared to furnish you conductors that will carry anything you want—in face of these facts, I say, I find it stated by this report that it is an impracticability. We think pretty well of it here, and we have got plenty of it in service. I would be glad to offer any assistance I can to demonstrate that fact.

W. H. JOHNSTONE: I am another aggrieved party. I did not receive a circular. I have been in the underground electric light business, for five or six years. I have been operating a plant in Philadelphia during that entire time with perfect and uniform success. We have constructed a plant in New York for the same purpose at a very great expense. The reason why gentlemen say the conduits are not practicable is that they have not seen them. They would not look at them. In 1883 we laid two miles of conduits in Chestnut street, Philadelphia. At the time the state of the manufacture of the insulation was in a somewhat primitive condition. To-day the manufacturers have advanced so far that they are willing to offer us wires with a guarantee of three or five years' duration of any insula- [illegible]

[illegible] tire thing and the conduits are nevertheless going right through underground. Now, when it comes to conduits, I have spent eight years with them. We started [illegible] the idea of grasping the entire subject. The [illegible] were electrical and mechanical. The electrical difficulty we knew we could deal with; the mechanical difficulty was the serious one. The first difficulty was expense. It is more expensive than creosoted wood, or asphalt or something of that kind, but when you put it down, you have a comprehensive thing that fulfills every possible idea you may suggest, and I now challenge any gentleman in this convention to ask me a question as to the distribution or handling of an electric light current for its commercial uses that I cannot right in this hall show him how it is done, and he will say to me, "That is right, I see how it is done." Now, that iron is the best material electrically I think we will all admit. That is the material for economy, and consequently I do not see what this report is constructed upon.

If you do not want to put them underground at your own risk, here stands an individual who is prepared to give bonds to put them in in any town or city in the country, and to make more money out of them than you are now making, if you will simply enter into an agreement that, if we do that, we shall have so much money for the trouble we are put to. You talk about abrading the conductor, drawing it in and out. You cannot abrade a lead cable. Lead does not cut. To put a cable overhead is a menace to life and property, and it is a very great economy to put them below. A resolution was passed a year ago by this intelligent body of gentlemen, stating there was no scheme presented that was commercially practical for putting electric light wires under ground. Now, I move to rescind that

We are laying in New York city conduits that have cost now quite a million of dollars. There has been laid about four miles up to the present time, and it has proven satisfactory to the minds of those people who were so bitterly opposed to this system. Now we have laid that conduit in Broadway and we are going to have it on 125th street, and I promise you that this coming summer the electric conductors in New York will all go under ground, and our good friend, Mr. Lynch, will have to reverse that report in a very short time.

MR. ECCLESINE: In listening to the report as carefully as I could, the first thing that struck me was the lack of any prejudice against recommending underground wire. The report was strained in its effort to recommend the adoption of underground circuits. I noticed that the number of communications that the gentlemen had solicited from the electric light companies and given consideration to were where underground conductors were failures; any success seemed to be overlooked or was not reached by the committee. It struck me also that the report of the committee was made up of these objections, and that therefore it was made so as to support the resolution that had declared in New York that underground conduits were not a success. To support the resolution this report was somewhat strained in its effort to sustain the belief that it is impracticable at present to go underground. There have been, I believe, for some time past, underground stations worked successfully, not one of which the report happened to name. I take Prof. Barrett's word for it that he has worked underground successfully, and yet Prof. Barrett is thoroughly known in this country, and the report fails to say anything about his experience, though I have no doubt if they had applied to him for his experience he would have sent willingly what information he had. In fact, all the information the report brings is damaging to underground systems. But the resolution that is to be supported by this report, which was passed last August, I think was one of a very sweeping nature. It was the effort of people to say, "we don't want to go underground, and, therefore, we will say boldly we cannot go underground." The electric light companies that have answered the gentlemen of the committee are evidently not desirous of going underground, but I think the people of the country are desirous to have them go underground.

They will be compelled to go underground by public opinion. Now nothing can be done without an earnest effort; and I do not think there is any earnest effort on the part of the committee to find how to go underground, but a very strong and earnest effort to find how not to go underground. When the report of the committee comes up for adoption I propose then to move a resolution rescinding the resolution passed last August. I propose to do that not because of the opinions of the people, but because of the facts that exist. There are gentlemen here who can testify to the fact that underground lighting has been successfully performed, where the men wanted to do it.

T. CARPENTER SMITH: I do not stand here to declare that overhead wires are dangerous or that the wires have to go underground. I believe I may, after our experience of nearly three years with under-

[illegible] circuits at an experience of six years of over [illegible] work [illegible] properly done [illegible] good [illegible] good workmanship and careful [illegible] safest method of distributing power known [illegible]. When you take into consideration the [illegible] of power [illegible] distributed through [illegible] light wires of overhead circuits, taking the [illegible] of New York or the [illegible] city of Philadelphia and comparing it with the accidents that occur every [illegible] form of transmitting power you find that it is incomparably safer. The case that I know [illegible] is in our own town of Philadelphia. I do not quite know of how many [illegible] overhead [illegible] there are in that city, [illegible] I judge I am rather within the mark when I say 100 miles.

Mr. DeCamp: Two hundred.

Mr. Smith: We have in Philadelphia, I believe, in [illegible] of 100 miles of street car track. Now, in these two hundred miles which Mr. De Camp [illegible] Philadelphia we are distributing [illegible] the neighborhood of three or four thousand horse power and we are doing that on an average of sixteen hours a day. When you consider that on any one of these overhead wires the whole current of the dynamo representing from fifty to sixty-five horse power can be realized not at every mile of that wire or at every foot of that wire but at every one-thousandth of an inch you see the potentiality of that distribution is enormously greater than anything else that can be calculated. In Philadelphia last year there has been one death from an arc light current, caused at a fire by a fireman cutting a telephone wire which dropped across an old underwriter's circuit and coiled itself up in two or three rings where it struck the ground. A little boy running across the street ran across this wire and in his endeavor to get away from the shock twisted the wire around himself and fell in the gutter and was picked up dead. What do we find in the miles of car tracks operated by cable companies? Twelve deaths were caused where people fell off the cars or were knocked down by the cars and were run over. Everybody uses the cable cars more or less; they are a great public convenience; so are the electric lights. Why is it that people think the cable cars more of a convenience than the electric lights? Simply because the cable cars have broken down a dozen times and driven it home to the mind of every man in that city that the cable cars must not be interfered with on any account, while the electric lights have not broken down and on account of the good service they have done they do not get proper recognition from the public. I want to put myself on record as a strong and earnest advocate of overhead [illegible] where it is possible. They are easy to repair; they are easily kept in order, if there is anything wrong with them it is quickly seen; but on the other hand I must say I do not consider that this report is at all a fair one to the underground wires. When any company wishes to adopt a new system, using, perhaps, some particular form of electric apparatus, do they go around and ask companies who are not using that system what their opinion of it is? Not much; they pick out men who are using that system and go to them to see what has been their success with it. They are not content with taking the say so of people; they try to find out the reasons for its failure. Now I am not aware that I have ever seen that circular sent out by Mr. Lynch's committee. I represent the Keystone Construction company, Philadelphia, and we are [illegible] underground station. We are doing so [illegible] we could not help it. If we could have gone overhead we would have adopted the overhead system.

We have had a great deal of trouble with underground wires, but somehow have managed [illegible] lights going straight along. It has cost [illegible] than any similar amount of overhead [illegible] I know of. When we went into this [illegible] experimenting way. There [illegible] country who could tell us anything [illegible] I [illegible] for myself, when I first went into [illegible] some seventeen years ago [illegible] where we made submarine [illegible]. I [illegible] opportunity of seeing a great [illegible] that happened to ocean cables. We [illegible] up the cables and found [illegible] more mechanical than electrical [illegible] this alternate current [illegible] great storm of assertion [illegible] alternate currents the in[illegible] great. We have had not one [illegible] or anything but [illegible]. We have [illegible] that you can use [illegible] get proper [illegible] men as [illegible] them with [illegible] and [illegible]

[illegible]

miles of cable six years ago have very much bearing on this question, for it is only within the last two or three years that a really intelligent attempt has been made to put in underground service. I do not want to say anything about conduits. I am interested in conduits, and therefore keep away from them and do not want to say anything about them. The great trouble we have to face is the question of distribution. I am free to say I consider the question of distribution of high tension arc light currents the gravest and most serious case we have to consider. The distribution of low tension incandescent current I think we may say has been solved. The Edison company is doing enough with that to definitely settle the question. They are doing it commercially. When it comes to the distribution of high tension alternate current for incandescent service I am free to say I think it is perfectly practicable and can be made a commercial success. When a man rents an arc light he can rent it for three months and when he ceases to use that light, if you do not remove the service entirely from his building, you are simply wasting the power by running through so many miles in a short time; by unnecessary wear you are losing money steadily. With incandescent, however, when a man cuts off a current and does not use it in his house, you do not lose anything. You have a trifle less to charge by empty wire, but there is no actual work done on that wire and you lose very little. I most sincerely trust that this report will not go forth as the voice of this convention. I think the resolution passed last August stating that the underground work so far was not a success was an ill-advised one. I believe the time has come when this association has got to face the music. Underground work will have to be put in and the sooner you do it, or make some honest effort to do it of yourselves without compulsion the sooner there will be a let-up on this tremendous public pressure to put them all underground without reference to circumstances and conditions. In the center of a crowded city I think no one who has been in Philadelphia, New York or Chicago will deny that the presence of the poles is a nuisance; they are obstructions and to some extent they are a danger. In small country towns and in outside suburbs, I do not consider that the overhead wires are half as much of a nuisance or a danger as underground wires. Now I want to be thoroughly understood as to what I mean by the danger of a lighting circuit. We have been favored with a large number of communications from a distinguished electrical engineer as to the frightful danger of overhead high tension circuits and he is very anxious to put an apparatus on all such lines which from the moment of the grounding occurring will immediately shut the circuit off. That may be his idea of safety. He wants to do that to protect the eight or ten linemen who are presumably men who understand the danger of their business and will take proper precautions against it. To do that he is willing to risk of the lives of the unoffending public who may be jammed in a ferry-slip or in the theater or on a large public thoroughfare or in a railroad station by having the entire light shut off instantly and left in total darkness. Now that is a form of danger which I think is infinitely greater than the little danger that exists from grounding on a high tension line overhead which is only interfered with by men who know what they are going up these poles to do. For that reason I think that perhaps that as far as we know at present the underground service is perhaps more liable to interruption, but against that we have to set this fact, that you need not hesitate on an alternating transformer system, and I am speaking of that entirely now, you can run one of these high tensions grounded. Ferranti, in England, proposes to do nothing else. Under the transformer system each house is a unit; a man who puts his own wire in a proper condition cannot affect his neighbor. With the arc light system you cannot do that, there may be a break and you will have to let your lights go out. For that reason I propose to leave arc lights out of the question. I am putting up overhead wire every day, and I do stand ready to put down underground if any body will pay the price.

Mr. Lockwood, Detroit: I am one of the seven who, in answering the report of the committee on underground wires, answered that we had tried the underground system. I represent the Thomson-Houston Electric Light company of Detroit, where the underground system was tried for a little more than one year, and was discontinued a little over one year ago to-day. Now, our current was from 1,800 to 2,000 volts. As Mr. Smith says, the question of underground work not exceeding 1,000 volts is one that I do not think any well posted electrical man present doubts is practicable, consequently, the discussion on the former underground system, where they used telegraph and telephone wires, does not apply to currents of over 1,000 volts. Now, I think the report or blank that was sent out by the committee was an exceedingly good one inasmuch as it focused the question right down to one that had used currents exceeding 1,000 volts and inquired for what period of time it has been [illegible] operated. I should like very much to have Mr. [illegible] and Prof. Barrett tell us in reference [illegible] 1,000 volts is the potential, what [illegible] applied to these conductors, and how long [illegible] operation. I have understood, from reports [illegible] by Mr. Sunny and [illegible] a large amount of the wire used here in Chicago [illegible]. I would like to ask if there [illegible] with [illegible] beyond that [illegible] exceeding 2,000 that have been [illegible] the length [illegible] and the time it [illegible]

Prof. Barrett: We started in to use them about a year or a year and a half ago. I think at that time we put in the Western Electric system. In that first plant I think we put in twelve miles of the Western Electric cable and six miles of kerite. That has been in service about a year and a half. Last year I put in a forty-two mile cable, and I sent out, and I have got a part of every cable manufactured in the country. I told the gentlemen what I wanted to use this cable for. They made their own price, and I am in the condition of my friend here when he held his pocket-book up. That is the way to get insulation—pay for it. We have now 55 miles of underground cable for the lighting service of the city. I think, in the matter of high tension, if you will ask Mr Sunny here, he will be prepared to give you more information than I can, but from the last report, I understand we have somewhere in the neighborhood of 1,200 arc lights. This wire is all underground and has been in service for five or six years.

Mr. Sunny: I stated at the Pittsburgh convention, and subsequently at the New York convention, what the condition of affairs was in Chicago with regard to underground cable. At the Pittsburgh convention, a year ago, I stated that we were in a very bad condition; that we had to throw out entirely two different styles of cable, and have finally put in a cable manufactured by the Western Electric company here—a lead-covered cable with very thick insulation, an insulation thickness of three-sixteenths of an inch all around the copper conductor. At New York I stated that with six or seven months' experience of a large cable we had but four cases of interruption. One of these cases was a mechanical injury, and two were defects in the cable, and one we could not trace. Since the New York convention, to my knowledge, we have had no cause of trouble that could be traced to any imperfections in the cable. We have had some trouble, but they were owing to poor work in making the joints. From a scientific standpoint we are getting along very nicely in the matter of working arc light currents through underground conductors. Prof. Barrett is using a current in his work of about 900 volts—perhaps he gets as high as 1,200 volts. We put through our cables all the way from 2,000 to 3,000 volts, and sometimes go higher. Of course, I cannot say how long the cables that we have now—that have been in use for just about a year, and have only given us four cases of trouble—are going to last, or how long they are going to furnish that satisfactory service; but just at this time they seem to be in first-class condition; they are doing all for us that we expected they would, and we are perfectly satisfied with them. Scientifically it is all right; the only objection we have is a financial one. I made up some figures a few days ago, as follows: The cost of circuit reconstruction and maintenance of conduit amounted, for three months, to $9,610.95. That was for 1,194 lamps for eight hours a day for ninety days, or 959,680 lamp hours. You see the cost of underground conductors is a trifle more than one cent per lamp hour over and above what it would cost on an aerial conductor. Now, you will say, if we had nothing but aerial conductors we would still have the item of circuit reconstruction. That is very true, but I have left out the question of underground conductors so far as the repair on electrical machinery is concerned. It is no question in our minds at all, but that we put $200 to $300 worth of expense every month on account of repairs to the electrical apparatus that are made necessary, owing to our underground cable; so that I think it is perfectly right to say that if our wires were on poles in the streets, the troubles I have enumerated would be eliminated. We figure, therefore, that from a scientific and practical standpoint underground cables are all right. From a financial standpoint they are costing us a trifle more than one cent per lamp hour more than aerial conductors. That does not include the interest on the additional cost of the investment.

T. Carpenter Smith: I should like to ask Mr. Sunny what rent he is paying per mile for each circuit. He includes in his figures conduit rental. I would like to ask him how the conduits are rented. I know that in one case the conduit rent was such that in three years the company could have owned and put down its own conduits, and a great deal better conduits than they were renting. In comparing these with aerial lines you must get the first cost of aerial and underground lines, and the cost of making them. It is not fair to charge the fact that you have to pay a certain price to a ring or board, or commissioner, or another owner who has got an exclusive privilege, and compels you to go into it. In our Philadelphia station we had precisely that condition of affairs. We were threatened to have to go into the conduit of a particular company organized by a ring. We fought them and beat them. We mean to get our own conduits, and then we will know what we will have.

Mr. Sunny: The conduit rent is a thousand dollars per year per duct. The duct will hold three electric light cables. So that the rent per mile for conductor is about $333.33.

Mr. Smith: We can lay down a 16 duct box, which at that rate would accommodate fifty wires at a cost complete of a little over $5,000 a mile.

Mr. Lockwood, Detroit: Prof. Barrett, in giving the figures as to the current used here for the city lighting, states that he uses a current which we all know to be about 900 volts potential. That comes within the range of what we all know to be a practical current for underground use. Mr. Sunny, I believe, is the only one who has had experience for any length of time with currents exceeding 1,000 volts underground. I understand he has had more success during the last year than heretofore; but during that period he states the expenses to be a little over $96. I would like to ask Mr. Sunny about these few troubles which he says they have had within the last year—whether they were simply troubles with joints, or whether they were troubles which necessitated taking out a part of those cables.

Mr. Sunny: The item of circuit reconstruction which was included in the $9,610 was for going over joints in manholes, for pulling out some sections of cable and repiecing and for taking out and renewing some wires under

sidewalk. It included everything that we did with the plant that we could not charge to construction, everything that we did to the plant that did not add to its earning capacity. We took it six months ago; we were in good shape; all the reconstruction that we ought to have done was done, and from that time on we considered that any charge that we would have to make for reconstruction would be a charge that we could count on having from month to month, as far ahead in the future as we could see.

MR. LOCKWOOD: I would like to ask Mr. Sunny if he includes conduit rent. If so, what amount is conduit rent?

MR. SUNNY: Nothing that can be legitimately charged to construction is put into that account. It is renewing something that we paid for some time ago.

PROF. BARRETT: My friend here is trying to analyze that expense account as between the overhead construction and the underground. Now taking it for granted that you had an overhead construction, how much would be the difference?

MR. LOCKWOOD: What I am trying to make is not anything against the underground, but for it; I am trying to bring out the facts. We all know what it costs to keep and maintain an overhead system, and that includes small repairs and replacing wires. Mr. Sunny has been giving us the actual expenses of the underground system, and if he will tell us what the rent is we shall be able to make a comparison.

MR. SUNNY: The items are: Circuit, reconstruction, $3,100; maintenance of conduit, $2,200. I might say in connection that the conduit needs a great deal of attention. It is one of the first ever put down. It was put down five years ago. Street rollers have crushed it here and there, and we have had to enlarge some of the manholes. If you put down a conduit as it can be put down to-day, it would not cost you as much as that to maintain it. It would not require three or four men going around town every day in the week pumping out the water and drawing out the gas. But this, as we have it here, is costing us $2,200 for three months to keep it up. The conduit rent is $3,400. The rebates on account of bad service or no service is $790.

MR. LOCKWOOD: Then I understand that the expense of the maintenance department, including rebates and necessary repairs which every system, whether overhead or underground, must have, is approximately $6,200 for six months; that during that period Mr. Sunny's company has been having its greatest success with underground wires. I would like to know now if there is anyone in the convention who has actually used underground conductors with a potential exceeding 1,000 volts, who has a record which makes a better showing of what has been done than this one of Mr. Sunny's.

E. A. SPERRY, Chicago: This question that has been brought up I might answer in this way: that in the last four years we have been operating on State street here an underground system of 1,800 volts, and about 18 to 20 amperes; and entering into the construction of that underground system has been every conceivable kind of cable, as the extension of our lines has, from time to time, required it. First, we used the conduit as fast as it was put in; latterly we have been using iron pipes. I find no trouble in using the iron pipes. As to accurate data with regard to the cost of maintenance of this underground system, I will give it later, but I am not in possession of it now. I do not think, however, that that account, figured in lamp hours, would reach any such point, including rental of conduits, as has been named here. It may be that it is owing to the fact that our lines are only about three miles in extent, and the station is operated on, of course, a smaller plan. We are operating now another station in the city here with 1,300 volts, with a record of no shut-down whatever, and a record of over a megohm as actual insulating resistance every morning. This latter construction is all underground, as I said, and is made of improved modern cable and is put in iron pipes and under sidewalk. This being more than a thousand volts I think comes under the question.

MR. LOCKWOOD: As I understand the gentleman, he says they have in all about three miles of underground wire, and that it has been in use about four years. I would ask whether all the wire in use on those short circuits is the wire put in four years ago, or whether it is the wire that has been put in in the place of the other?

MR SPERRY: There has been a great deal of changing, but that was owing to the pioneer work that we had to do. We had to take what we could get. If it did not prove satisfactory we had to pull it out and put in something else. Now, the first cables that were used for the first three months undoubtedly are all out. As to the next cables that were put in, parts of them are out. I have in mind now one cable put in years weeks ago that is now running and running successfully. That is to my mind a very great illustration of what the cable can be made to do if it is properly put in. Extra precautions were taken.

THE CHAIRMAN: What electromotive force, please, Mr. Sperry?

MR. SPERRY: Sixteen hundred to eighteen hundred volts.

T. CARPENTER SMITH: Mr. Sunny has stated that his rental of conduits and repairs to conduits amounted together to $5,600. Now he is in the unfortunate position of renting a conduit and then having to pay for it in the bargain, which is precisely the general result where you rent conduits from a company in whose power you are, so to speak. That leaves as the total cost of Mr. Sunny's conduit for underground service, reconstruction, etc., $4,000, or about $13 a month. I would like to ask Mr. Sunny how many miles of wire there are in proportion to the miles of conduit?

MR. WILMERDING: We make out the total mileage of underground conductors as about 78 miles. There are 90 miles of duct and about seven and one-half miles of conduit.

MR. LYNCH: How many wires in each duct?

MR. WILMERDING: Not more than three.

MR. LYNCH: I would like to call Mr. Sunny's attention to the following figures: Rental of conduits, $[illegible] one quarter, that would be $13,[illegible] per year. That would be 13½ miles of duct at $1,000 per mile per duct. Three miles of duct give only forty miles of wire. The superintendent, Mr. Wilmerding, just said there were 78 miles of wire underground.

MR. SUNNY: We have 78 miles of circuit, and I [illegible] estimate, as Mr. Lynch has suggested, that there are about forty miles of that circuit in the conduits, the balance under the sidewalks and in buildings.

MR. LYNCH: You do not have to pay any rental for the subsidiary ducts which you use, that is, in the cellars and over the buildings.

MR SUNNY: No, sir.

CHAS. COOPER, of Brooklyn: While this underground business is very interesting electrically, and we are very glad to hear the opinions of the electricians on the subject, to the practical operators of electric light plants it would seem that this question all gets down at present to this—that the experience so far had has not been flattering, and that the only thing that has not been said in favor of the underground system so far has been by men interested in underground conduits or cables, or by our friend, Prof. Barrett, of Chicago, who is in the fortunate position of having the municipality of Chicago to pay his bills. Unfortunately our company has to pay its own bills. Prof. Barrett made some remarks about thirteen years' service, eight years' service and five years' service. I think I may say that Mr. Barrett's experience in electric lighting for the city of Chicago does not extend over three years.

MR COOPER: Mr. Johnstone, who speaks for the Johnstone underground conduit, has made only one claim so far of a successful conduit, and that is of the one in the city of New York, which has not yet been used. The experience of New York city so far leads to the belief that when his conduit is used it will be, as the others have been, a failure. There would not have been so much underground conduit put down in the city of New York if it was not for the fact that the company that is putting them down has received many hundred thousand dollars from people who thought there was millions in it. As Mayor Hewitt remarked, the commission in the city of New York consisted of four men, who he supposed knew as little about electricity as any four men in the city of New York, and he added that he could frankly say so, because he was one of the commission. Now, I for one would be very glad indeed to have this system of underground conduits prove a success, I have been in communication with a great many companies indirectly or directly who use an underground conduit for arc light wire.

In Brooklyn we are very anxious to do the same. We have a commission in the city of Brooklyn composed of three of our best known professors of electricity, who, I can say, are honest men, appointed by Seth Low, the reform mayor of the city of Brooklyn. One is Prof. Plympton of the Polytechnic, another, Dr. Raymond of the Adelphi academy. Prof. Plympton traveled all over the world and went into cities where he was told that it was all underground, coming to Chicago where they did not have an overhead wire, and much to his surprise finding that they had more here than they had in Brooklyn; he has traveled to Paris, Berlin, London and every city in the world where he heard they had used the underground system, and much to his surprise found that none of them had been in successful operation, and came back and, like an honest man, made his report to the mayor of Brooklyn to the effect that up to the present time there is no system that is of practical use for the car light system of the electric lighting. We are fortunate, I say, in the fact that we have an honest underground commission. Mr. Barrett has started in the electric light field. We are glad to see him there. Mr. Barrett has the city of Chicago at his back. It is a rich city; it will probably not be so rich when it gets through with this conduit business. When they get through with the system, when they have used it a few years, they will do just exactly what the other companies have done in every city on the face of the globe; they will abandon it. You cannot do electric arc lighting and make it a commercial success with underground conduits

MR. JOHNSTONE: The only people that are advocating underground operation, our learned friend states, are those that are interested. Why not? The only people who are opposed to it are those who have some money invested in overhead wires and do not want to take them down. It reduces itself to that fact In Philadelphia, if you will permit me, I will tell you a little underground experience that Mr. Lockwood has asked about. When we put this electric light station in operation in 1883, we started with three circuits varying from a mile to a mile and a half in length. We could not find in the market wires that anybody would guarantee; but the Benedict & Burr Manufacturing company of Waterbury, Conn., had to put up a plant somewhere in Connecticut, and they started by simply using pure para rubber insulation. Now it showed as high a resistance as you could imagine, and we thought that we had under the direction of our engineer a wire that would stand almost anything. In the course of three or four months we began to have trouble; we had grounds, we had burn-outs, we had all sorts of things, nevertheless that wire, by means of its accessibility, we could find out where the trouble was. We kept that up for about three years. Some of that wire was still in use when we were bought out. But the failure was due to the want of experience. We believed that we would reach the point of success, and now there are a large number of thousands of dollars invested in manufacturing underground wire for commercial use.

MR. DECAMP: I conceived it would be very difficult to get answers to the blanks which would enable that committee to perform a very onerous duty, and enable them to express an opinion as to what had been done without laying themselves open to very severe criticism and prejudice, and I was glad that I was not on that committee. When I was told that they formulated that blank in a manner to get at the real facts, and not an [illegible] I would [illegible] The [illegible] [illegible] that [illegible] [illegible] only [illegible] [illegible] experience. [illegible] [illegible] that I [illegible] [illegible] had [illegible] those who [illegible] [illegible] in that direction. The [illegible] are comparatively small [illegible] evidence of the [illegible] hard [illegible] that has got into the heads of the [illegible] I think that a man is a grievous [illegible] will spend hundreds and thousands of [illegible] over again anything that I [illegible] failed in absolutely. Now I am [illegible] in this convention have had me reiterate [illegible] again. There are three things connected with this underground business. First, insulation; second, some method of distributing your business, and after that is accomplished is it a commercial success. Now there are three things that you have got to deal with and until you have exhausted them you have no need to bother your heads about anything else. Now comes first the perfect insulation. Mr. Smith holds out from his pocket an insulation which will answer the purpose. Where is the man who tells what that cable or wire will cost when that perfect insulation is put on it? I have not yet heard an estimate of it. Now, the distribution of it by some properly constructed conduit comes next. So far as my knowledge goes of general construction, the plan for distribution of wires by the conduit in which Mr. Johnstone is so greatly interested is as good, and I am prepared to say better than, anything I have seen, because I have used it. I do not agree with him as to its construction of iron, but that is a collateral question, it can be made out of anything. Now to come down to the financial success, a statement was made to me yesterday substantially the same as Mr. Sunny made here to-day as the experience of that company. That must be wrong. One cent an hour added to the cost of lights must be wrong. That exceeds anything that I could ever imagine connected with it if it was worth doing at all. I thought we ought to be wise enough to stop short of incurring any such expense as this, and I did not take the risk of fixing that in my mind until I had the opportunity of asking Mr. Sunny whether my understanding of that was correct. He told me it was substantially correct, and he reiterates that statement on the floor of the convention to-day. Now what does that mean? Mr. Sunny's experience was an average of eight hours per day in the twenty four; that is a very favorable record. It is less than we had in Philadelphia. Our average is something over eleven hours; that means eleven cents a day it is going to cost us. Now I have been in the electric lighting business a long time, and I do not think we could get a dollar of capital into that business on any such representations of cost as that, because there are other costs which are very large, and which you always have with you. Now Mr. Johnstone seems to refer back to Philadelphia, and while I regret that I am dragged into that subject, I am compelled to answer it or admit it by my silence. I do not propose to admit it. Mr. Johnstone had been manager of that company, I will venture to say, spending one day in the week, perhaps, in looking after the details of the station, and the other six days advancing the interests of the conduit company. Now I want to say right here that is my belief. Mr. Johnstone goes on and makes his statement about buying that company out. I will make no reference to that any further than to say that he sold it out at about ten times its intrinsic value. When I went into that station I accepted it just as if it was not worth while to do anything else, but I never had anything to do except to look after the interests of my superiors, the directors, and I said: "Now, here, there is no further use for my accepting the statement. I have the facilities at hand to see whether this thing can be made to pay on the basis on which I have been educated to consider things as paying." There were no records of that institution, so far as its internal operation was concerned, that were worth anything. Everything was reported, so far as the circuits were concerned, as being in fairly good order; that there were some defects, owing to the embarrassed condition of the company. We were running a blower and it could not be dispensed with, because of the liability of gas to accumulate in the conduit. Let it be there and we have an explosion. What is the cause of the explosion? Defect in the wires reported in fairly good condition, defects in the insulation causing a spark, and the spark causing an explosion. That does not speak well for the perfect insulation and perfect state of underground wire, and that was a sufficient reason for the continued expense of running a blower, and it was run. Further effort was made to ventilate the conduit and improve it. Then it was reported that there was no evidence of gas. We ran it probably five or six months with from 100 to 125 or 130 lights, a short circuit. With the 100 to 130 lights the company did not pay its expenses. I am only mentioning this now to show you that there was no financial success in that particular instance. I will also say that there were from six to fifteen explosions of greater or less degree in those dates. Nothing [illegible] happened to seriously injure the property of the company, the record was not kept very closely, but after the condition of the conduit was reported to me as being in such a shape that there was no liability to these explosions, we had one. That was got out of very cheaply. We settled the damages for, I think, $200, and I consider that we were very fortunate. Now, that is the history of the Philadelphia company, which Mr. Johnstone quotes, and the only thing that he has to quote. I did what I think any gentlemen in this convention would do. I went to the directors and said we can survive under this [illegible] with an object in view, but the chances of success the

pecuniary remuneration does not justify us in taking the risk. They followed my suggestion and we abandoned the arc light business. We took up then what came next. We were not in incandescent business, but we had that elephant on our hands, what were we going to do with it? I said suppose we take up the question of incandescent lightning on a small scale and see if we cannot get some knowledge of our own out of that experience. A given amount of money was appropriated to enable us to put in a small incandescent plant and run it and gain our experience. The amount of money expended direetly in that one object exceeded by a few hundred dollars what I estimated it, but two and a half times as much was spent for what I had no idea would arise in expenses. We found the whole of these conduits from one end to the other were broken and smashed up so that we could not get anywhere through them on account of these explosions that had taken place in them from accumulated gases, caused by defective insulation. Two and a half times as much money was required to be spent before we could put into anything like decent operation our experimental incandescent station. That station was always run at a loss. When I got at the books and got down to hard pan, I charged to profit and loss $46,000 in the accumulations of five years; there was no other place that you could put it. Furthermore, it ought to have been twice that, but I could not do that, because that would have wiped us out of existence. I knew we had no real existence as a company, but I felt it my bound duty to keep an existence on paper, and that is about where we stand to-day in that company. I do not know much outside of the electric light business; that has absorbed my whole attention, but in order to strengthen my position in this I am bound to draw a comparison to show whether I know what I am talking about in relation to that particular company or whether Mr. Johnstone knows what he is talking about. I had no interest at stake there except to make that station successful. The capital of that company is $500,000; it is blocked out for one hundred lights, there remains in the treasury of the company a little more than half the stock.

Now as to the comparative cost of operating wires underground or overhead. The late chairman of this convention took the wind out of my sails in one of the earlier meetings by bluffing me off when I made a statement as to the cost of maintenance of overhead wires. I did not have the spunk to stand up to that thing, although I believed myself right at the time; but I accredited him with a superior knowledge which I do not believe now that he had. Now leaving out this very mooted question of rented conduit, whether you rent from a conduit company or put down the conduit yourself, and that is a question that is always with you, you cannot get rid of it. I make this statement here that the cost of maintaining overhead circuits from one station running about eleven hundred lights, exclusively on overhead wires for the year 1888, was eighty-two one hundredths of a cent per lamp burned. In that I do not include the labor item. I have taken that out and I have made a calculation, and I will make a statement here which you can rely upon as being correct, and within the possibilities of every electric light station in the country doing business in a large city. I have taken the labor of line men, not one-third of whose time is probably engaged on this particular work, and charged it to that particular account. It is one and seven sixhundredths of one per cent. of the cost of the lights. Mr. Stanly's statement of the cost within the last three months, as he puts it, is nearly three times the cost for the whole year 1888, of that station. Now there is nothing left out of that. About fifty miles of [illegible] wire embraced in the maintenance account was put up in the summer of 1881, and I am entirely within [illegible] when I say there has not been five miles of that wire abandoned or replaced. It is just as good [illegible] as it was when put up. We have had a ground [illegible] underground station, on this miserable low potential current; that has been there a week and we [illegible]. It is playing hide and seek with us [illegible]. A statement was made last August in N[illegible] that was so supremely ridiculous to me [illegible] I could not understand it. In the first [illegible] a long stretch of continuous con[illegible]. What on earth is [illegible]; if the conduit is use[illegible] conduit it is good for [illegible] I [illegible] idea as it; the state[illegible] of two and a half [illegible]. Every man in this [illegible] about it knows that [illegible] Mr. Leach informs me [illegible] allows three, and [illegible] that he gets in. [illegible] the city of New [illegible] figured up that [illegible] there the [illegible]

[illegible]

New York in proportion to the demand for it is a picayune business. It is essentially a business of progression or retrogression, there is no standstill to it and the men who have got their money invested in these companies see their salvation in the extension of business. They are broad men, and I think, as I have said before, that there are better men back of the electrical lighting interest than ever went into any new enterprise, financially and from every other standpoint. Now it will not do for anybody to say that all these companies do not want a thing and will not put their money into it. They would put their money in mighty quick if they saw a chance of getting it out just the same as they did in the first place. What was the condition of the New York company, the Baltimore company or the Philadelphia company when they started? They were very much alike. The Philadelphia company was started in 1881 by a concession from the council that they would allow them to occupy one street on condition that they light that street for one year without cost so that the state might determine whether electric lighting was practicable and a desirable thing to have. By the time that plant was completed and was run one year there was nearly $200,000 in solid cash put in. That was eight years ago, when we had not anything to fall back upon; a man had to take his own risk; if there had been a failure the investment would not have been worth anything. There was pretty much the same condition in Baltimore; capital came into it with just that sort of risks. It was a hard struggle, and with all the advantages of overhead wires to bring order out of chaos until they got it on to a basis where it was a fairly paying business if properly and carefully managed. Now that same element is in the electric lighting business. I can go and raise all the capital that is necessary to put our wires underground if I can show that there is a fair and reasonable chance of success, but I say to-day I have not seen it. Now I will go anywhere to look at these things, but when I go I must have more than my own opportunity of looking at them. I do not want anything covered. That has been my unfortunate experience where I have looked into these underground services; they have shown me all the good points. About the underground wires or overhead wires there is a good deal that you know that outside parties cannot say. Now that is the difficulty of getting information.

Now I will go back to the question here—the question of perfect insulation; and when I say perfect insulation, I mean that we can handle it with the same facilities without interruption to our business as we can on an overhead wire. The economical construction of the conduit can be safely left to the ingenious minds of the people. I am perfectly willing to leave it there, but I claim that so far as we have gone now from a financial standpoint it has been demonstrated beyond question that underground wires are impracticable. Underground currents must have a terminal somewhere; and the risks of that current are very much greater underground than overhead. We have an underground circuit on North Broad street. It is not ours; it was put there and is maintained by a gentleman who thinks he knows a good deal more about it than we do, and we are perfectly willing that he should think so; and still on a damp night or a night that was not very damp, I have repeatedly said to the men, "If there is anything out of order in these lamps, let them stay out; it is not safe to go in these holes." That is what is called perfectly insulated underground wire.

Mr. Smith: I move that the report be received and be printed, but that it is the sense of this convention that it is not yet in a position to make any recommendation as to the feasibility or practicability of underground conduits, but that it continues the committee for the purpose of getting further information.

Prof. Barrett. I will only take a few minutes' time. This subject is quite familiar to me. About fifteen years ago I had occasion to discuss the underground circuit as applicable to the city of Chicago. I wrote to one of my friends, Mr. Morrison, and Mr. Morrison replied that the only objection he had to it was the earth current. What sounds familiar to me to-day is the fact that when the matter was being discussed before our electric statisticians and experts here from all parts of the country that the earth current entered into it perfect insulation was impossible. At that time our city authorities thought well enough of it to pass an ordinance compelling all wires to go under ground. I think the first electric light that was ever on exhibition here was handled by myself for the city — a little two-light Brush machine. I never saw one before. While experimenting with the machine I discovered that the current was a pretty stiff thing to go against, and impressed on the members of the council that what in my opinion was the dangerous thing was to permit electric light wires to be strung in our streets and alleys. I found that that was a good precaution to take. The fire departments through the country invariably insist upon the removal of these wires. You cannot get as good service out of the fire department if they know they have a [illegible] with a current on to deal with. I am not [illegible] the matter now on a financial basis, but as the representative of the people to protect the people. Therefore we have never had an overhead [illegible] in Chicago. There are times here [illegible] impracticable to open up the streets, and then after a [illegible] company dares to go [illegible] I assume the responsibility [illegible] a temporary permit to go there, but no [illegible] to erect and maintain electric light [illegible] in Chicago. When Mr. Cooper was here first I detailed one of my assistants to show him what we had, and he reported back that there were no wires underground here—that everything was on poles; but at that time we had to remove about 2,800 miles of wire from our streets, and eleven or twelve hundred poles. As to the cost of construction of underground service, I think it can be done to-day at about 75 per cent. of the cost it would be when the original plant was put in. If you look at our streets you will find we have about three hundred street lights here, fairly good looking posts, wires all underground, substantial conduits built, and they stand us in about $300 apiece as they stand on the streets. The cost to maintain them is simply nothing.

Mr. Morrison: How many lights are being run by the city?

Prof. Barrett: We had 285 in service last night that belong to the city, with a capacity of 500, as soon as our finances permit us to extend it.

Mr. Weeks. What is the tension?

Prof. Barrett. I think about a thousand volts.

Mr. Weeks. You have been working one year, have you?

Prof. Barrett: I have been working one year and a half with 104 of these lights, and the last year we introduced the balance of them. This is a subject in which I have not a great deal of interest, except to be prepared, as I am prepared, to show you conclusively what I doing here. We have a variety of construction. We have given them all an opportunity, and they all do well. We do so also with the cables, and we have as good a line of service, I think, with the cables as any line on the earth.

Mr. F. Ridlon, (Boston): We have had one difficulty in Boston with the underground service, which does not seem to have been touched upon at all. We were very much surprised a few weeks ago to have the insurance people intimate to us that they would have to increase our insurance, because of electric lighting, as they considered it an extra hazardous risk. This was striking us right home. We felt that it was necessary to know the reason of it, as they had heretofore expressed the utmost confidence in electricity as an illuminator, and considered it the safest method of illumination. It became necessary to inquire and see what the difficulty was and where it originated. On investigation, we got the representatives of the insurance companies together, their experts and their inspectors, and the electric light people, and their statement was that there had been within the past six months a large increase in the fires in the city of Boston occasioned by electricity, or electric light wires. We investigated each one, and found that a very large proportion of these fires had been caused by the underground service, which had been in operation about one year, perhaps a little longer. The amount of underground wire was, perhaps, between forty and fifty miles. We have nearly 600 miles of the overhead wire in Boston, and perhaps two or three hundred miles of it has been in operation some five or six years, perhaps nearly seven. The alarming increase of these fires has been within the past eight months much more than equaling all the fires and costing a loss which was quite a large amount, whereas in the previous five years of overhead lighting insurance companies had not paid one dollar of loss. It became necessary to investigate this thing closely, and it finally proved that in almost eight out of ten of these fires they were caused by the underground service, and it is now quite a question whether we can afford to continue the service which was found to be an extra hazardous risk, and have to pay more for our lighting, or else we are liable to lose our insurance.

Mr. Weeks: I would like to read a couple of letters from two electricians who are well known not only in America, but throughout the world. The first is from William Hochhausen of New York, addressed to the editor of the Kansas City *Globe*. The second is from Prof. Elihu Thompson. Mr. Weeks then read the letters referred to.

Mr. Cooper, Brooklyn: I offer this as an amendment to the resolution: The National Electric Light association does not feel that the experience of which it has knowledge is of such a nature as to justify it in believing that any practical commercial method of putting high tension arc light wires carrying a current of over a thousand volts underground has been brought to its attention. I offer that as a substitute.

Dr. Moses: As I understand 1,066 circulars were sent out directed to all the different enterprises connected with the electric lighting in the country.

One or two perhaps have not received this circular, but the mass of them have, and have either thought it unworthy of reply or have not replied from the fact that they are not particularly interested in the subject as yet. I imagine that those who have not replied have been in outlying cities where this subject has not come to their attention, nor is it likely to. The fact is, seven people have replied to these inquiries. The fact is that only one city in the country has looked into this thing carefully. In view of these facts I think it would be better for us to stay any action on this subject and till we have more experience. I am a great believer in letting well alone. The electric light interest has grown wonderfully in the last ten years. Agitation on this subject now would tend to check it and I think it is our duty to prevent any such agitation. When you are quite sure that you have a system by which electric light wires can be buried, then I say spend all the millions you have lying around and put them there. But until you are sure of your work, I say it would be folly to put in your underground wires. They may be of the

[illegible] should be sure of [illegible] to place the wires [illegible] put. Now [illegible] that we are [illegible] upon at present. I [illegible] that Lord Bacon [illegible] should not act. He says that those [illegible] from considering [illegible] decide [illegible] question. Let [illegible] work out its own salvation.

MR. MORRISON: I would ask the permission of the convention to quote a letter which had completely passed out of my mind, and was brought to my attention by a gentleman from Kansas City. From my standpoint it is perhaps unfortunate that so few practical experiments have been made in the direction of underground [illegible] those engaged in the electric lighting business. The excuse for that, if excuse you may call it, has been quoted by prominent speakers who have felt the sting of incompetent work in that direction, notably Mr. DeCamp of Philadelphia. I regret the personal turn that some of these discussions have taken, but I believe that this is one of the most important subjects which we are called upon to face, and that we cannot keep it down. It will be brought up every year in your counsels, and I think the convention owes a debt of gratitude to the gentlemen who have composed this committee and have done the best they could. Mr. Smith of Philadelphia, who always brings to every subject he considers a degree of intelligence not surpassed by any member of this convention, has given you a full and broad statement from his standpoint, and that is the standpoint of experience, the best of teachers, the hardest of masters. There is, however, a point in his statement which needs to be carefully considered. He said he had had no experience with the high tension arc light system, and we all know that it is only within a brief period that we have been able to conduct the low tension systems with any degree of economy, or any promise of return for money invested; so that the experience given by Mr. Smith, while it is good as far as it goes, does not cover the domain in which many of the gentlemen in this association have invested their money, and to whom capitalists are looking for a return of the money that they have invested. A subject of this kind cannot be fairly considered nor properly adjusted in a day, much less in the short time allowed on the floor of this convention. This convention is banded together for the purpose of obtaining from year to year such information as the experience of its members can suggest. We are not expected to frame perfect laws or give information which is infallible. We are only travelers on the road of progress, and as we go along we note each day what we have observed, and give it to you for what it is worth. Prof. Barrett alluded to a matter that occurred some fifteen years ago. I think it was in 1874 or 1875 that I was superintendent of the fire alarm telegraph of Baltimore. I was directed by the council of that city to report upon the feasibility and probable cost of placing the wires in that city underground. I had correspondence with every country on the face of the globe where underground wires had been used. A full and exhaustive report was compiled from that correspondence. The result of the information which I was able to gather was that it was perfectly feasible to place such wires underground, and the cost at which that work could be done at that time in Baltimore was named. Among the many pieces of information which I obtained was one from the director general of telegraph, of the German Empire. In the city of Cologne in the year which my correspondence took place, they dug up a cable that had been made by Siemens Brothers, of Berlin, which had been underground and had not been touched for twenty-one years. They had not lost an hour's time by interruption in that cable, and they had not put five cents of repairs on it. They dug it up and put in its place a cable of greater capacity for carrying the current than the one which had been there all those years. The feasibility of placing those wires underground was demonstrated beyond a doubt. So much for the matter that at that time brought Prof. Barrett and myself close together, and which perhaps, had as much to do with inducing him to enter the field of underground wiring as anything else did. The conditions which govern the laying of telegraph and telephone wires and those which govern the electric lighting business are entirely different; but no one has ever heard me say that it is not feasible to put high tension electric light wires underground. I am not prepared to put myself in that position. On the fifth day of the current month I received a letter from the editor of the Kansas City *Globe* asking me whether in my opinion any satisfactory system had been invented, and whether arc electric lights could be placed in a subway with telegraph and telephone wires, also if high pressure electric light wire would be compelled to discontinue business if the underground wire law went into effect. To those questions I made the following reply:

BALTIMORE, Feb. 11.—It is, in my judgment, possible to construct a subway and to make it available for high as well as low tension systems of electric lighting. Such a subway, however, has never been constructed in this country. The efforts in that direction, notably in New York and Chicago, have succeeded only in crippling the electric light service, preventing the general public from reaping so fully the benefit from it as when the lines are permitted to be used overhead. The demand for subway construction comes, in a general way, from legislatures and citizens who know little or nothing about its requirements or defects. Intelligent legislation cannot be had unless the legislators possess this knowledge or take sufficient time and make sufficient expenditure of money to possess it. For this reason all experiments in this direction should be made at the expense of those desiring it. It is therefore my opinion that all subway construction should be done at the expense of the city or state, and when by them completed should be submitted to competent judges as to their availability for the purposes intended. Then introduce the wires in a limited way, that experience may prove the correctness of the system, after which order [illegible] to place their wires [illegible] that [illegible] for the [illegible] maintenance. [illegible] cost of maintenance, [illegible] that municipal [illegible] government [illegible] private enterprise for the [illegible] public. The citizen has greater [illegible] necessity of electricity for light and power [illegible] the investment necessary [illegible] underground. If this course is adopted by [illegible] of Missouri [illegible] other [illegible] electric light companies using high pressure [illegible] to the abandonment of these enterprises.

J. F. MORRISON.

That about covers the ground from my [illegible] I have been familiar with every effort in the [illegible] and consider the work done in Chicago perhaps the most intelligent of any experiments in this line in the United States. The story of the result is told by Mr. Sunny. He has shown you that the subway system of Chicago is not perfect, and the tremendous cost entailed in keeping the works in such condition as to enable them to deliver the product of the central station to his customers. I believe those evils can be remedied and a plan found by which the lines may be carried underground. Until that time comes, no body of men, state legislatures or others, have a right to put their hands in your pockets or mine and take from us the results of our labor, and invest it in a plan which lessens their taxation and imposes a double burden upon us.

I look forward to such men as Professor Barrett and Mr. Johnston, and the men who are engaged in the manufacture of insulated cables for underground purposes, for the solution of this question. It is they who will reap the benefit of these things. Prof. Barrett is an officer representing this municipality, and the better the service and the more beautiful the streets which we will have when all these obstructions are removed, as well as the safety of these subways, are objects to him. It will be a benefit to the electrical manufacturing companies because of the vast returns which they are bound to gain when this system has been perfected, and that it will be perfected there is not the slightest doubt in my mind.

The question upon the resolution of Mr. Cooper was then put, and a vote taken.

During the calling of the roll, when Mr. DeCamp's name was called, a separate vote was recorded for him as the representative of four different companies. The question whether he had the right to move then an individual vote provoked some discussion and was settled by Mr. DeCamp withdrawing three votes.

The substitute was lost. The question recurring upon the original resolution of Mr. Smith, Mr. DeCamp offered an amendment, adding to the resolution the following words:

"Provided, however, that the passage of this resolution shall be without prejudice to the resolution passed at the meeting held in New York in August last, until a further report is made by that committee."

The amendment was lost by a vote of 31 to 37.

G. H. ROE, San Francisco: There is a little difference of opinion. The convention seems to be divided and the division is principally between the operating men and the supply men, and it occurred to me if we could arrive at the Scotch verdict of "not proven" it might facilitate matters. This is the resolution: "Resolved, That while the appliances and devices for operating electric light wires underground are being continually improved, and promise ultimately to render practical the operating of all electric light wires underground, they have not yet reached such a degree of perfection as would justify this convention in declaring itself in favor of underground wires for central station arc lighting."

The secretary announced that 28 had voted for the amendment and 32 against it.

A recount was ordered. 31 voted aye and 39 no and the amendment was declared lost.

Mr. Morrison offered a resolution, providing that the resolution be laid on the table and made the special order of the day for 12 o'clock, Feb. 21. The motion was carried.

The convention then adjourned until the following day, Thursday, at 9:30 A. M.

Thursday's Proceedings.

The convention was called to order Thursday morning by President Duncan, who announced that the first business in order would be the reading of communications by the secretary.

Secretary Garratt then read a letter addressed to President Duncan by David J. Harris, manager of the electrical exhibition of the St. Louis Exposition & Music Hall association, stating that an extensive general exhibition would be held at St. Louis, commencing on or before September 4, 1889, continuing for a period of six weeks. It was stated that it was intended to make the electrical exhibition the finest ever held in the country. The letter continued: "No charge will be made for power or space to exhibitors who are members of your association, and ample accommodations will be made for such exhibits. It is expected that articles for this exhibition will be shipped to St. Louis and returned for one-half the usual rates. The St. Louis Exposition & Music Hall association cordially invite the National Electric Light association to meet at St. Louis during the time of this electrical exhibition. The exhibition building occupies four large blocks, cost $7[illegible], and contains two halls, the larger having a seating capacity for 5,[illegible] persons. The smaller hall, known as Entertainment hall, which is fitted in the finest style, will be placed at your disposal, in which to hold your convention free of charge, including all the necessary service, light, heat, etc. Ample hotel accommodation will be provided at very reasonable rates."

The communication was received and filed.

[illegible]

[illegible] utive committee has examined the financial report made by [illegible] plish during the past four months. It is entirely satisfied with the results that have been obtained, and unanimously [illegible] further term of six months. While the committee is not unanimous [illegible] entirely willing to have the experiment tried for six months more, and is very hopeful that he secretary will be able to make the office so successful as to justify its continuance indefinitely. On the occasion of this convention the executive committee has striven, at the suggestion of a number of people, to make an electrical exhibit that would represent as fully as possible the electric light and power service.

As has no doubt been observed, many of the manufacturers have gone to a large expense to make the display both complete and instructive. It was decided that in justice to the exhibitors a larger attendance of persons to view the exhibit than was represented in the association ought to be assured, and the committee, therefore, has sent out about 50,000 invitations, addressing them to persons connected with the management of the large industries and the educational institutions. So far the attendance has been of a character that is encouraging both to the committee and the exhibitors, and everything points to the accomplishment of the result aimed at, namely, the educating of the general public in the progress in electrical development.

MR. MASON: I desire to ask a question in connection with this report. The report recites that at a meeting in Pittsburgh the action of the president was confirmed, and names a date somewhat subsequent to the opening of the offices in New York. If I am at liberty to, I would like to know whether the provision was made by the executive committee of the payment of the salary of the secretary, when these quarters were opened.

MR. SUNNY: Yes, sir, it was.

MR. MORRISON: Arrangements have been made by the executive committee, which will cover that hiatus. It was not possible to make that arrangement at the time of our meeting from the fact that the belief of the executive committee is that no services should be accepted by the association without rendering an equivalent for them. It has made it necessary to make provision for that contingency.

The report of the executive committee was adopted.

MR. STEUART: It is necessary for us to-day to elect officers for the ensuing year, and I, therefore, would present a resolution to the effect that the house now go into a committee of the whole for the purpose of electing officers for the ensuing year.

The motion to go into committee of the whole for the purpose of nominating officers was carried, and the president appointed Arthur Steuart chairman of the committee.

THE CHAIRMAN: The first thing to be done in preparation of the work of the committee of the whole is to request all those who are not active voting members of the association to retire from the room. It is necessary to do this in order that we may transact this business. It has to be done with closed doors, while we shall be very glad to see all visitors as soon as the committee rises. The chair will appoint Col. Beetle as doorkeeper.

NOMINATIONS [illegible]

MR. HINES: I beg to nominate for president of the National Electric Light association for the ensuing term Samuel A. Duncan of Pittsburgh. The nomination was seconded.

MR. DUNCAN: Mr. Chairman, while I feel grateful for the compliment intended to be paid [illegible], I rise to decline most emphatically the nomination. You have honored me with the position [illegible] the term of one year. I feel [illegible] in the report, which has been made [illegible] executive committee, showing the financial status [illegible] the [illegible] of the association [illegible] accomplished in a very short space of time [illegible] [illegible] I have no personal [illegible]. I [illegible] My desire has been [illegible] [illegible] When [illegible] [illegible]

Western Electrician.

EVERY SATURDAY.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome, and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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THIS issue of the WESTERN ELECTRICIAN is undoubtedly the best convention number of an electrical journal ever published. It consists of sixty pages, and contains an accurate and complete report of the meeting of the National Electric Light association in Chicago, and is [illegible] to the mails immediately at the [illegible] of the convention and several hours in advance of any other paper.

[illegible] the weekly WESTERN ELECTRICIAN [illegible] reprint of the DAILY WESTERN ELECTRICIAN [illegible] appeared at 7 o'clock [illegible] the convention. The ap[illegible] It ap[illegible] promptly on time every morning with a shorthand report of the previous day's pro[illegible]

[illegible] was after [illegible] that the title was printed in red ink, the advertising pages were bordered by red lines, while the letter press pages were beautifully printed and copiously illustrated. It was a credit to both printer and engraver, a triumph of class paper enterprise, and the most ambitious undertaking in the history of electrical journalism.

It was unquestionably the most successful hit ever made by an electrical newspaper. The DAILY WESTERN ELECTRICIAN was popular, besides being of great value to members of the association, inasmuch as it gave them ready to hand a full report of the previous day's proceedings for consultation and reference at the current day's meeting.

Commendations were heard on all sides, and the paper has the satisfaction of knowing that its enterprise on this occasion was fully appreciated. The WESTERN ELECTRICIAN for February 16th was the best number of an electrical journal that had ever been issued up to that time. That piece of enterprise has now been supplemented by the successful publication of a daily electrical journal, recording in full the proceedings of a large representative body of scientists discussing technical subjects, and again by the publication of our issue of February 23d—the most complete convention number of an electrical journal ever seen.

The record of the WESTERN ELECTRICIAN since its inception, less than twenty months ago, is something to be proud of. It is to-day leading all its contemporaries without exception, and its future promises even greater things.

THE convention of the National Electric Light association at Chicago, just ended, was unquestionably the most successful ever held by that body. The attendance of members was unusually large, the papers read showed deep thought and extensive scientific research, and besides treated of live issues in a practical, business-like manner. The discussions were also marked by a familiarity with details of the subjects considered. The expression of opinion was free, and all the members were evidently guided by a desire to promote the interest of the association and community. While members of the association were discussing the papers read before them, the general public was becoming acquainted with the operations of the electrical machines displayed. This exhibition of electrical apparatus was the most extensive that had yet been made in connection with the electric light conventions. Never before had the association such excellent facilities for making an elaborate display, never before had it received such encouragement in its efforts to enlighten the people on most important problems, and never before was it represented by such an earnest, hard-working and disinterested committee as that which conducted the preparations for the recent convention. The convention and exposition were successful, and all who in any way assisted in the arrangements for the affair should feel proud of this success. It reflects credit on all.

A MEETING of the committee on exhibitions of the National Electric Light association was held in the assembly room at the Exposition building Friday morning. B. E. Sunny presided, and in calling the committee to order, commented on the success of the exhibition held in connection with the convention. He said this remarkable success, considering the fact that the time at the disposal of the committee was limited, indicated that a general electrical exhibition in Exposition building, Chicago, would prove eminently successful. It was evident, he said, that the people of Chicago were deeply interested, and would [illegible] electrical exposition their attention. It [illegible] such an exhibition in Chicago a year hence, and the Exposition company [illegible] the event success[illegible] secretary of the company [illegible] to confer with the committee. Mr. Reynolds accordingly assured the committee of the desire of the Exposition company to have the exhibition held at Chicago, and said the company was ready to assume the direction of the exhibition or cooperate with the committee and assist it in every way to make the display successful. D. P. Perry of Chicago, A. F. Mason of Boston, A. H. Patterson of New York, and J. W. Godfrey of New York expressed themselves in favor of the proposition, and the chairman was authorized to appoint a committee of five to confer with the exhibitors and make arrangements for a general meeting to consider the matter. The committee named by Chairman Sunny follows: A. H. Patterson, New York; J. H. Shay, F. W. Horne, W. H. McKinlock and D. P. Perry, Chicago. It was decided not to have an exhibit at the September convention at Niagara Falls.

THE decision of the lower court in the case of Edison and Swan against Holland and the Anglo-American Brush company was reversed by the Appeal court at London, England, according to a cable despatch received last Tuesday. The lower court had decided that Edison's specifications were not explicit enough to enable a workman to construct filaments, but the higher court sustained the Edison and Swan patents.

FREDERICK N. BOSSON, superintendent of exhibits at the convention of the National Electric Light association, was kept busy throughout the meeting, but he was never too busy to listen to the requests of all, though many were unreasonable, and to extend to every visitor and exhibitor all the assistance in his power. He deserves the thanks of the association, the exhibitors and the visitors, and from the expressions of approval heard on all sides it can safely be said that he has the best wishes of all who attended the convention in any capacity.

IT was demonstrated during the sessions of the National Electric Light association at Chicago this week, that the general public is interested in electricity, that the people desire to become acquainted with the devices employed in the development of electrical energy, and that especially in Chicago there is an excellent opportunity to increase the interest in the subject and impart confidence to the public mind by holding a general electrical exposition. The attendance at the exhibition, especially during the evening, was simply marvelous, and it was at times necessary to deny admission to those who presented themselves, as the spacious halls were overcrowded. On Thursday night 18,000 tickets of admission were collected after 7 o'clock. This will give some idea of the vast number of persons who attended the convention and examined the apparatus on exhibition. Every day the halls of the big building were crowded from early in the morning until late at night.

IN connection with the electric light convention, the *Scientific American* refers to the fact that, in many conventions of scientific men, valuable time is wasted in listening to papers that contain nothing that is new, instructive or entertaining, but are read merely through courtesy to the author. An interesting comparison is drawn. In the electrical field of to-day, apparatus and methods change so quickly that a new device or idea is scarcely arrived when that which is still more novel is treading upon its heels. The electrical men come from all parts of the country at stated intervals to compare notes concerning these; it being of vital importance, and by no means an easy task, to keep abreast of all that is going on in a particular line. There is no time for idle talk, for oratory, for ancient history, for dissertations on things in general, with an occasional remark on the subject under discussion. The chairman has no traditions to follow, and no mercy; the committee, to whom all papers must be submitted, rarely pass one that does not treat of a live issue. When it is remembered that many of the best practical minds of the country gather at these conventions, and that in their line they are, it is conceded, leading the world, it is not, perhaps, going too far to say that to attend these conventions is to get a liberal education in applied electrics.

(Continued from page 107.)

tion to do what it started out to do. Thanking you for all the courtesies you have extended the chair, I decline the nomination.

MR. PERRY, of Providence: Four years ago, amid much boisterous tumult without and some little trouble within, in this city, in the month of February, was born the National Electric Light association. Present at that time, earnestly working, willing ever to put aside anything that might affect him personally for the good of the association, a gentleman who is with us to-day and has been with us at every meeting of the association, one who has been careful and thorough in all investigations, conservative in all his conclusions, honest and conscientious in all his convictions—that gentleman is known to you all; I nominate him for president of this association for the ensuing year—Edwin R. Weeks of Kansas City.

The nomination was seconded by Mr. DeCamp.

DR. MOSES, New York: I hear several seconds to that nomination, one among them is my own; therefore, although it seems to be the general desire to second it, I rise to second it in order to be able to add my testimony to that which has been given by Mr. Perry; and also, at the same time, to premise it by saying that in the declaration of the president who has just thrown off the toga we see an act of self-abnegation which deserves our unanimous approval. The action of Mr. Duncan is such as to make us believe that there is a spirit pervading this association which was born with it, has grown with it, and which will continue to live with it—that is, harmonious action for the general advantage of electric lighting interests. Rotation in office has been always a favorite theory in this government, and it is a pleasant thing to see one who has all the elements of success in him, and a strong support among the members of this association, declining the honor in favor of one whose capability he must recognize and whose friendship, I think, he possesses. I second the motion nominating Mr. Weeks of Kansas City.

MR. MAHER, of Albany: I rise to second the nomination of Mr. Weeks, and to heartily indorse what has been so gracefully said by both the gentlemen who have preceded me. The presidency of the National Electric Light association is an honor that any man might well be proud of; and I am sure that I voice the sentiments of all the gentlemen here present, members of this organization, when I say that in the choice of Mr. Weeks we choose one who, in all his efforts during the existence of this organization, has done much to make it what it is to-day. I heartily indorse and second the nomination of Mr. Weeks.

Nominations were closed.

MR. COOPER: For first vice-president of this association I have to propose to this association the name of a gentleman who has long been associated with it in all its work, a gentleman who is well known to all of you, so well known that it is hardly necessary to say a word in his favor. He is a gentleman whom you all know, and whom to know is to esteem him. I nominate Mr. A. J. De Camp, of Philadelphia.

MR. RIDLON, Boston: I know of no gentleman who is better qualified by his position in the electric lighting interest than A. J. DeCamp. I am very glad to second the nomination.

MR. CRAM, Boston: While I feel that the gentleman who has just been nominated for the position of first vice president of this association is so well known to, perhaps, every member of this association, both personally and by reputation, as an able manager of one of the largest electric lighting companies in the country—a combination, I should perhaps say, of electric lighting companies—that no word is necessary in support of his nomination for the office, nevertheless it gives me great pleasure to second his nomination, and to add just this one word in support of him: He is a man who has been strongly identified with the association from its earliest days as an earnest, active and conscientious worker.

MR. BIEDLER, Baltimore: I will add that Mr. De Camp possesses, in my opinion, those traits that are covered in a practical, skillful and successful electric light man. He has manifested upon this floor, in the deliberations of this convention, those qualities that eminently fit him and commend him for the first offices in the gift of this association. When we can get such men to accept office, they honor us in the acceptance. We can know that those interests which are paramount above all others to this association will be conserved, and we can confidently feel that comprehensive thought upon the subject, drawn from experience and intelligence, will encompass all that pertains to and may be developed in the science for the practical and general good of electric light and power.

MR. MASON, Boston: It is hardly necessary that another should second this nomination, and yet I suppose we would like to go all around the circle and say the words which we all have to say in regard to this nomination; but perhaps for the rest of us it would be best to

"Let silence covet speech
Than vain words clutch for what they cannot reach."

G. A. Redman, of Rochester, nominated E. A. Maher, of Albany, for second vice-president.

MR. CURTISS, Cleveland: It gives me great pleasure to second this nomination. I have known Mr. Maher personally for many years. He is one of the oldest and one of the ablest electric light men in this country. I believe that he can bring to this convention an experience that will be beneficial to us all; that he will aid to raise this convention to that point that we will all want to see it raised. Not only is he a man of great experience in managing a company and in running a station, but he is as parliamentarian, I believe, the peer of any man on this floor. He is even the peer of our good friend Morrison on my right.

H. M. DAGGETT: I would like to submit a list for members of the executive committee of the ensuing year. I would nominate B. Rhodes of Niagara Falls, B. E. Sunny of Chicago, George A. Redman of Rochester, C. R. Huntley of Buffalo, Dr. Otto A. Moses of New York, E. T. Lynch, jr., of Brooklyn, P. H. Alexander of Boston, J. F. Morrison of Baltimore and T. Carpenter Smith, of Philadelphia.

MR. BROWN: I would move that the same ticket be nominated, with the substitution for the name of Mr. Sunny of Charles R. Fabian of Toledo. In doing this I want to state that my object is to have the executive committee consist entirely of central station operators, representatives, or at least of those men representing current companies, so called. That is, we should exclude from the executive committee all men who are engaged in the supply business or in the manufacturing business. Another reason for substituting Mr. Fabian's name for that of Mr. Sunny is that Mr. Fabian not only [illegible] a large electric light plant, but also is a representative gas man. The gas men have on many occasions given membership to electric light men. I do not think the electric light associations have extended equal courtesies to the gas men. Mr. Fabian is not known to most of us, I presume, but whoever does know him will know him to be a whole-souled, genial man. He expected to be here at this convention, and hoped to be, but sent his regrets. He is a member of the association and I hope that his name will be placed on the executive committee.

DR. MOSES, New York: The gentleman has touched the key note in the discussion. He has spoken of the necessity of this executive committee being composed of men who represent central stations alone. That very thought has been in my mind since the nomination, and before. I, myself, do not represent such an institution and yet I think that this association should be composed, not only of men who represent stations, but all other interests in which electricity plays an important part. Nevertheless it is my sincere conviction that the ultimate success of this association depends upon its guidance by those who are interested, and who represent central station lighting. The tendency of the development to-day of this industry is toward central stations. I think the time has come when all inventors are directing their efforts to make their apparatus fit on central station work. If a man has a cigar light he wants it attached to the central station distributed throughout the city. If he has a sewing machine or a printing press he wants it run from the central station. I recollect some years ago, when I was at a convention of this association held in Baltimore, and stopped at the Reynard Hotel, I was annoyed during the night by the reverberations of an engine in the basement. Electric lights were supplied throughout the building. I complained to the proprietor that his foundations were not sufficiently deep. He said he had gone very deep with them, but that it was impossible for him to prevent that vibration, consequently he and we would have to submit to it until a central station was established in the city of Baltimore. Mr Reynard had put his isolated plant into operation at a time when the prices were very much higher than now, when electric lighting by incandescents was a luxury. The tendency of the development of this industry is toward the possessors and guiders of central stations. At the same time these people must be supplied. What do the central station people put in operation? That which is brought to them to be used. Who furnishes that? The supply men; yet at the same time the option of deciding whether to use this or that product, and to determine upon the excellences of them, rests solely with the purchaser, and that is the electric central station men. Now, this association, as I understand it, has been formed for the purpose of bringing together those employed in central station lighting and other branches of electricity and those who furnish supplies. It has been successfully done, and I hope that both of these interests will recognize at once their due position. I, myself, come in somewhat in an intermediate capacity. My opinion has been sought frequently by those on both sides, and I feel myself somewhat in a position to give them advice. They have come to me, and in honoring me with this nomination, I look upon myself not in that honorable position that Mr. Francisco put me in as a leader through the difficulties, but as a peacemaker. If it is the opinion of this convention that only one of these interests should be represented upon the executive committee, I feel as if I should respectfully withdraw my name from it.

T. CARPENTER SMITH, Philadelphia: I feel a little modesty in rising to speak on a nomination for the executive committee, having myself been nominated, but I think it due to the convention to state what I think would be for its best interest, and what I think we will all of us realize in a short time, and that is, the extreme value of Mr. Sunny as a member of the executive committee [applause].

S. A. DUNCAN: I nominate F. A. Cheney, of Elmira, N. Y., as a member of the executive committee.

MR. MORRISON: Being in the same position as that described by Mr. Smith, having had my name placed in nomination as a member of the executive committee, I had intended to sit silent pending the proceedings of this committee. I cannot, however, sit silent and see the possibility of having drift from your active service in the cause of the electric light association a man so conspicuous for his interest in all electric lighting matters as Mr. B. E. Sunny. Mr. B. E. Sunny is president of the Chicago Arc Light company. I think that the appointment of Mr. Sunny, by one of the foremost electrical manufacturing companies of this country, showing, as it did, that they recognized in him a peculiar fitness for the electrical lighting business because he had so faithfully and well discharged his duties as president of this company, is, or ought to be, an additional reason why he should be appointed on this executive committee. The perfect appointment of this convention, the vast labor necessary to bring about the condition which you see before you and all that appertains to it, while due credit must be given to all the electrical people of Chicago, including the chief of the municipal electrical department, yet he with whom we have been brought [illegible] which they carry on their business. I believe that the manufacturers of apparatus, the manufacturers of [illegible] insulated wires and those who are spending their time and their money in endeavors to bring about the best plans of placing wires [illegible] and without them, your meetings twice a year would be comparatively valueless.

MR. FREEMAN: Manufacturers should be represented in the executive committee to lay before them from time to time the various advances that have been made, and in selecting Mr. Sunny it is to be said that he represented one of the most active and progressive companies in existence and should be kept upon the committee representing the manufacturers' interest, and I believe if the manufacturers were all here they would select Mr. Sunny as their representative, and I think it is necessary for us to keep him on that committee.

MR. MASON: I regret very much that one element has been introduced into this discussion, and I rise to protest against it with all the force that is in me. The reason stated here for the motion to drop Mr. Sunny and to introduce another name is an outrage to one half the members of this association, men who do not want and do not ask for any office, but who are told substantially that they can pay their dues and exhibit their goods but they must understand that they are not of the association, that they are an outside element. I think if that is the fact, the sooner the association is formed upon a different basis the better. This matter has not been introduced by those who are called here by some opprobrious name, "the supply men," but it has been introduced by the electric light men, the central station men. If this association is an electric light association, such language ought not to be permitted. If this association is an association of central station plants let it be so, and be called so. Personally, I say, it is a grievance to half of the members of the association to be told that they may come here, but should not hold any office in the gift of the association. I earnestly hope that Mr. Sunny's name will be retained on the committee.

MR. PERRY, of Providence: I regret most sincerely that this controversy should have been commenced, but I trust in the interests of peace that it will be terminated at a very early moment. The only objection urged against Mr. Sunny, and I speak with perfect freedom, for my name is not up for any office, is that he has brought to the discharge of his duties honesty of purpose and intelligence of execution. I trust, gentlemen, that the list of names presented for your consideration by Mr. Daggett will be unanimously adopted.

MR. KERR: I think that a man's eligibility for office should be determined by a certain position which he may hold, and that he should not be disqualified because he happens to be in some other business. I am very sorry that there seems to be a tendency to a dispute between men who sell electric light apparatus and other things connected therewith and those who operate them, and I hope that any such discussion will be avoided. If it is to arise, I mean to say, as one of those who are not connected with a central station, that I am very much interested in seeing this association an affair of men who are engaged in supplying light to the public.

MR. BROWN: In making the amendment to the original motion which I did, I had several reasons in [illegible] why it was more proper, as I thought, for me to make that motion than for any one else to make it, and in stating those reasons I think I will explain to Dr. Mason what, it seems, has rather touched him that I am not a central station man. I am not a man engaged exclusively in selling electric light lamps, but the business of the company which I represent covers not only manufacturing electric light apparatus, but also dealing in supplies. Therefore I thought that it was particularly appropriate that the expression of opinion which I have heard frequently [illegible] the floor of this convention, but outside, should come from a man who represented the different interests [illegible]. Another reason why I thought that such a motion as I made was proper as coming from me, was because I am personally acquainted with Mr. Sunny, and it would be understood by every one, I think, that there is no personal objection in my mind to Mr. Sunny. It was simply a matter of policy that I wanted to introduce here. Another reason was that I was on the nominating committee at New York. I was the chairman of that committee, and it was my own motion that Mr. Sunny should be [illegible] on the executive committee and made the [illegible] committee a position which he has [illegible] of every one. Another reason was that [illegible] which Mr. Sunny recently had with me [illegible] nomination, not his desire, but his determination [illegible] to serve on the executive committee ag[illegible] blame, if you might [illegible]

[illegible] I simply make [illegible] of my amendment to the [illegible]

General discussion followed, during the course of which [illegible] with [illegible] Mr. Cheney's [illegible] the committee [illegible] nomination of Mr. [illegible] A. Cheney for a place on the executive committee, the nomi[illegible]

[illegible] the nominations of members of the executive committee as originally nominated was then put and carried unanimously.

Action on the report of the committee of the whole was postponed.

[illegible] business in order according to the [illegible] the resolution of Mr. Smith: "That the thanks of the association be extended to the committee [illegible] continue and add to the committee on conduits and conductors Mr. Sunny, Mr. Sperry and Prof. Barrett, with a view to obtain further information, and that the sense of this association is that it is not yet in a position to make any recommendation for or against the placing of arc light circuits of over 1,000 volts potential on underground conductors."

[illegible] Mr. Smith [illegible] withdraw his motion.

MR. MORRISON: I beg to offer the following resolution:

"Resolved, That the report of the committee on conduits and conductors be recommitted to that committee, and that Messrs. Sperry, Barrett and Sunny be added to the committee, and that the committee be continued."

The motion was carried unanimously.

Mr. Cooper moved that the report of the committee of the whole recommending names for officers and executive committee be adopted.

The report of the committee of the whole was unanimously adopted, and, on motion of Mr. Morrison, the secretary was authorized to cast the ballot of the association for the list of officers and executive committee as reported.

MR. MORRISON: I move that the next place of meeting be designated as Niagara Falls, at a time in August which shall be designated by the executive committee, to suit collateral circumstances. I mean by that the meetings of conventions of a like character.

PROF. BARRETT: I put Minneapolis in nomination as a place of meeting.

Mr. Barrett withdrew his nomination. The motion of Mr. Morrison was adopted unanimously and Niagara Falls selected as the next place of meeting.

THE CHAIRMAN: The regular order of business will now be taken up, which will be a paper of Mr. S. E. Barton of Boston, Mass.

S. E. Barton read the following paper:

[illegible] LIGHT STATIONS AS FIRE RISKS.

[illegible] BARTON.

In the latter part of last year I was informed by your secretary, Mr. Garratt, that at this convention "the subject [illegible] relation to electrically illuminated buildings and also the question of electric light stations as fire risks" would receive attention, and I was asked by him to prepare [illegible] of these subjects.

I [illegible] acknowledge the honor I feel in being invited to speak before so scientific and large an assembly as this Convention of the National Electric Light association.

Through stress of circumstances my paper will be short, [illegible] touch [illegible] subjects in a general way.

Insurance companies, like yourselves, sometimes get involved in litigation, and it is my unhappy lot to have been drawn into that unfortunate condition, to the exclusion of [illegible] else, for the past two months. I offer [illegible] as a preliminary apology for what may [illegible]. Perhaps my misfortune in being caught in the [illegible] may prove to be your good fortune, because I am full to overflowing of the subject before me.

I cannot refrain, in the outset, from congratulating myself [illegible] in New England, upon the very cordial relations existing between ourselves and the electric lighting interests, and also upon the very favorable experience the underwriters of New England have met [illegible] on account [illegible]. Nor can I refrain from [illegible] experience has been in the [illegible] much more [illegible] being [illegible] England [illegible] exchange [illegible]

[illegible]

While the plain duty [illegible] in the public interest is, first to hold to a strict line of requirements any of you who may be tempted or compelled, through competitive pressure, to depart from what you know are safe practices, and, [illegible]ng done that, the underwriters' duty is not fulfilled until they have indorsed electrical illumination and power by the reduced premium charges that such combined action on the part of electrical and insurance interests is sure to warrant.

The two interests are [illegible] identical. Hand in hand they can accomplish much in reducing the enormous fire waste. Disunited and antagonistic to each other, your work will be slower in development. Competition among yourselves and no restraining supervision on our part will drive you to cheaper construction and maintenance of your work. More fire loss and higher premiums for insurance must inevitably be the result, while the public, still calling for your light because it is good, will be deterred to an injurious degree by reason of the increased insurance rates that will surely follow, such as have already been applied in some cases, and threatened in others.

The policy of insurance companies and organizations toward electric lighting or any hazard in fact, capable of being [illegible], should not be "to fit the punishment to the crime," but rather to lessen the crime, or endeavor to. In your case they will be [illegible] to undertake that policy without your co operation, and can succeed only with it. Without their co-operation, I think you would make but little headway in that direction.

In New England electric lighting is very popular with insurance men, particularly since it has, as applied to some risks, been included in the schedule of "improvements" for which a reduction in tariff is made. The energetic agent in his efforts to scoop in his competitors' pet risks does not fail to recommend the introduction of electric lights as a means of procuring a lower rate and securing the risk to himself. He thereby becomes your solicitor. He goes still further: in many cases he manifests his favor to you and serves his own interests by becoming an investor in your apparatus, and a promoter of your industry. Such a condition of things is but the natural outgrowth of a perfect harmony and co-operation between the two great interests. It ought to exist throughout the land.

By reason of faulty work which crept in during the early stages of electric lighting in Boston, numerous small fires which have occurred there have created a scare among insurance men, causing a threatened increase in rates unless a remedy was applied. The following notice just issued by the Boston Board of Underwriters indicates where they look to for relief.

"At a meeting of the Underwriters' committee, held Jan 28, 1889 it was voted that on and after May 1, 1889, all electric lighting and wiring companies' men, who are in any way responsible for any of the wiring, running of dynamos, or care and management of batteries for electric lighting, must hold a license from the New England Electric exchange. This rule applies to isolated plants and central stations alike, and is imperative. No exception to it will be made."

Such a rule may seem arbitrary to anyone not in sympathy with the objects sought by the "Exchange" (and there will always be found some objectors to any good movement) but after all I believe it is just the medicine needed for the complaint.

In regard to the electric light generating station, the situation is not a pleasing one to either party. Out of over 200 fire insurance companies doing business in Massachusetts, the electric light station is a prohibited risk with all but about 25 or 30 of them. The reasons for this interdiction are chiefly these: First, because electrical apparatus, and dynamos in particular, have been found to be very susceptible to large and uncertain damage in cases of small fires; secondly, because generating stations have too frequently been crowded into very hazardous and improper quarters, simply to get floor space and power at the smallest cost, without regard to permanency and ultimate results; lastly, and mainly, because insurance men, as a rule, do not understand the nature of the hazard and often fail to get enlightenment from those in charge of stations. Therefore a large majority of the companies adopt the course of all wise underwriters,—they "take the benefit of the doubt" and leave your station risks alone.

Judging from my own observation of the way in which electric light station risks are peddled about to find takers, and the rates that are charged by reason of there being so few takers, I am led to believe that the question of insurance is to many of you an unsatisfactory one. I cannot help thinking that, even with the present condition of station [illegible] risks, if the business as a whole were so [illegible] to show the aggregate premiums on the one side and the losses and expenses of doing the business on the other, a fair margin of profit would be shown. But no [illegible] general classification or account is made, and the [illegible] of those few companies that venture on your risks, [illegible] kept to themselves, so that others [illegible]

I [illegible] National Electric Light association [illegible] the purpose of which would be [illegible] to the aggregate premiums paid on [illegible] central station insurance. If such had been [illegible]

[illegible]

officer. No risk should be accepted by such an association until approved [illegible] certain standard [illegible] regular quarterly or [illegible] yearly inspection [illegible] to see that the standards [illegible] were maintained. Much valuable information as to improvements [illegible] semicated by such an association, or even by your own association.

In some such general way as I have suggested the question of central station insurance can be settled; but while the present tendency to temporary or makeshift installation shall continue, the question will hardly reach a satisfactory solution. Surely the capital invested in generating plants would seem to warrant some general action looking to the standardizing and maintenance of them, and their insurance at a moderate cost.

MR. MORRISON: I want to add my voice to one particular point. I want to call attention to that part of this very able paper in which reference is made to the lamentable condition of many of the electric light stations of this country, to the occupancy by electric light companies of old tumbled down buildings or any other place that they can poke apparatus into, at the least cost. This is doing more harm to the electric light business than all its antagonists put together. The one declaration made in that paper that the insurance companies of New England have been compelled to abandon the risk of electric light stations, is a sufficient warning to all those about to engage in that business that the only proper course to pursue is to erect substantial stations under intelligent supervision, and that a law ought to be passed in each state of the union where electric lighting is proposed placing such construction under the supervision of the government. The suggestions made in the paper with regard to obtaining such information will, I have no doubt, be carefully noted by our secretary who before the next meeting will doubtless furnish information on that subject. It is a matter of the greatest importance. It is one that touches your pocket nerve, and when you touch that you touch the most sensitive part of any man who has any capital engaged in the business.

MR. BARTON: I would like to state still further that it not only touches your pocket, but I am free to suggest it touches my heart to see what I believe to be one of the safest classes of risks that we can have at the present time, through no reasonable excuse whatever, in such a condition that insurance companies will not touch them as a general rule. I believe that in our business generally about 25 per cent. of the loss may be charged to what is known with us as moral hazard. I hold that this 25 per cent. should be eliminated from the electric lighting hazard, there is no such thing as moral hazard. Therefore, I say when we can have a class of risks with that one risk entirely wiped out, it does seem a shame and a pity that we cannot have the class so raised as to make it desirable for insurance companies at low rates. The present condition is due wholly, I think, to the fact of inconsiderate construction without regard to any permanency of the future condition, but simply to get a station at the least possible first cost. The matter is receiving considerable attention now in New England, and only recently, within the last two weeks, the electric light committee, of which I am the chairman, has been asked by the New England Insurance exchange to formulate a schedule for the purpose of making tariff rates upon central stations. Heretofore it has been done by the various committees and has been out of the control, or not in the control, of the electric lighting committee in any degree the question of making rates. They have been rated at what we call the flat method of rating without any regard to the real merits or demerits of the risk. We are now undertaking to formulate a schedule in which we shall assume a standard model risk at a very low rate. We shall then add in the way of deficiency, which we shall make a special charge for, those features which we believe contribute to the making of a central station a poor risk and which can be eliminated by changing, and it will be largely in the method of construction, internal as well as external, of modern fire appliances and of the arranging of switch-boards and things of that kind. We hope in a very short time to get a schedule formulated whereby electric light people can have some idea of what we, as insurance men, think should be done in order to improve your risks, and that will be put into general operation in New England, and I hope it will spread. I know for certain that New York state and that the New York city associations will adopt it as soon as we have issued it, and therefore it looks as though the insurance of central stations in the eastern part of the country was in a fair way to reach some sort of a solution, but still it lies in your hand, gentlemen, to make it what it should be, and it would remove very largely the feeling of prejudice that usually extends from the insurance companies to the public. When it becomes known, as it is generally known, that electric light central stations are so hazardous that insurance companies will not touch them, it will only go to increase the public prejudice against electric lighting in general. They conclude that there is something so mysterious and something so excessively hazardous about it that they do not want any of it.

MR. ALEXANDER: I regret very much that the announcement was made that Mr. Barton was to leave early this afternoon. I hope that the subject will be brought up again. I know that Mr. Barton and the insurance inspector of New England, both of whom are here, tried to form some worked out plan for central stations, so that a central station built in that manner should be considered a minimum risk. He had hoped no doubt that the association would take this matter up and would aid in perfecting such a plan. This will not be possible in his presence, but the inspector will remain here, and I hope the paper will be discussed and the side of the central station people [illegible] brought out as well as the other side.

THE CHAIRMAN. The point is this. We have a committee, as I understand it, who have asked for time. The chair is not yet informed whether the committee is ready to report, but it was in his mind that the subject would be made the first order of business this afternoon, to be taken up in connection with the report of that committee thus covering the whole question at one time.

MR. RIDLON. I beg to substitute B. H. Alexander who is president of the New England exchange to make that report. He has the data and the material with him on which he can make a report on that.

MR. ALEXANDER. I shall not be able to make a written report, but I believe that I can state the matter so that the association will understand it.

THE PRESIDENT. That being the case, the first order of business this afternoon will be the discussion on Mr. Barton's paper and the report of the committee on the New England exchange.

DR. MOSES. I have in my hand a pamphlet that has been sent to me, and I understand it has been extensively distributed throughout the United States. I will not comment on it, beyond merely reading its title, "The Comparative Danger to Life of the Alternating and Continuous Electric Currents." I have read this, and I will not lay before you the criticisms that this gentleman makes before the body now assembled. Those criticisms are not worthy of notice, but I have a resolution here which I think can express our views and which I would like to see adopted.

"WHEREAS, A certain individual, in order to gratify a personal resentment, has, in exaggerating the dangers of electric currents, striven to influence legislation so as to cause the introduction of electricity in the form of alternating current as a means or infliction of death on condemned criminals, therefore, be it

"Resolved, That the National Electric Light association earnestly protests against those efforts and unanimously resolves that the members of this body decline to allow any electric current under their control to be used for ignoble purposes."

A motion to lay on the table was put and lost and Dr. Moses' resolution was adopted.

The convention then took a recess until 2 o'clock p. m.

AFTERNOON SESSION.

THE PRESIDENT. The first business in order this afternoon is the report of the committee on the New England exchange and the discussion of Mr Barton's paper on insurance.

MR. ALEXANDER. I am not the chairman of the committee that had the matter in hand, but I was requested by the chairman of the committee to bring before you this matter of the New England Electric exchange, with which I have been connected since its inception, and of which I have been the president since its organization. I have not prepared a written report, but as the secretary of the exchange wisely put in some numbers of its paper which contains a stenographic report of the proceedings, I may, with its aid, make the object of the exchange well understood, and the subject may prove interesting to you.

In March of last year there seemed to be a great deal of dissatisfaction expressed as to certain insurance rules pertaining to wiring, and in order to see how the electrical fraternity stood on this matter I prepared a circular which, in common with other gentlemen in the business, I have sent around to every station superintendent and station company. The circular reads as follows:

"Comments having been made by electric light people regarding the rules issued by the Insurance exchange for regulating light installations, it seems desirable that the representatives of electric light companies and superintendents of central stations should meet the electric light committee of the Insurance exchange and their inspectors, to talk over equitable means for harmonizing the object of insurance inspection and the effect of installation of electric light plant."

The circular then goes on to call a meeting at a certain time. There was quite a large attendance at the meeting which followed, about sixty or seventy gentlemen being present. A number of electrical matters were discussed, and it was finally proposed to form an organization to be called the New England Electric exchange, which should be, so to say, a mediator between what then seemed to be conflicting interests. The organization was completed by the choice of officers, and right here let me say that in that organization only manufacturing companies and electric light companies were to be admitted to membership. The call read as follows:

"Every one actually engaged in manufacturing or installing electric light and electric power apparatus, or in operating commercially an electric light or power plant, will be eligible to membership of the exchange."

This comes in pat in reflecting upon what was said this morning here regarding the division. We have found it to work there admirably. The manufacturer of electric apparatus is just as much interested, it seems to me, in good electric light installation as the company operating the same. We took the ground that if an engineers' society was formed a man connecting the steam pipes, and doing that work intelligently, should be considered an engineer just the same as the engineer running the engine, and, in fact, as you know, it requires more skill to build an engine than to run it. We did not, however, admit the man that makes the pipe or burns the brick out of which the foundation for that engine is built. So we admitted manufacturing companies and companies operating electric stations, but did not admit what you term here to-day supply men, for the reasons given. This meeting was held on the 2d day of April, and a constitution was adopted, and also a [illegible]. The exchange [illegible] companies [illegible] [illegible] were [illegible] and [illegible] heard Mr. Barton's [illegible] [illegible] that he [illegible] perfect [illegible] of electric light [illegible]. We took the ground that electric light was the [illegible] illuminant in existence [illegible] the ground that electric light plant [illegible] [illegible] installed and therefore we [illegible] and we have done so [illegible] [illegible] operating electric light and [illegible] companies. The result soon however [illegible] less than six months from the time that the organization was [illegible] to insurance companies of their [illegible] made a reduction in insurance rates on all [illegible] and manufacturing establishments where electric light was used as the only illuminant, a reduction of 10 per cent on incandescent and 5 per cent on arc light plants. Meanwhile a great many difficulties came up between different companies, which the board of reference, as we called them at first, but whom we now call the board of directors, always amicably settled. I know of places where the electric wires were run and did considerable damage to the telephone interest in the city. The telephone interest being there first, naturally felt very much aggrieved. We settled such matters between the companies without recourse to law. The prime object always has been to look for good work. Manufacturing companies and operating companies alike had a common interest to have good work done. The manufacturer said that a poor apparatus well installed would operate a great deal better than a good apparatus poorly installed, and therefore, the interest was common, just the same as I believe it is here. Lately, however some trouble arose in the city of Boston regarding fires that were said to have occurred there from electric wires, and the board of underwriters of the city of Boston proposed to adopt more stringent rules. We invited them to meet with us and the tariff committee of the Boston Fire Underwriters union and the electric light committee of the New England exchange and the inspectors of the Insurance exchange, and, in common with them, we discussed this matter, and as a consequence this circular was issued Feb. 1:

"To Electric Light and Wiring Companies:

"It has been decided by the Boston Fire Underwriters union that on and after March 1, 1889, they will not approve underwriters' wire for electric light wiring in any manner inside of buildings. Moisture-proof and water-proof wire must be used. All loops, or drops, from poles or other outside structures, to and into buildings, must also be of a heavy moisture proof insulation. It must first be submitted to the electrical inspector for his approval. This rule applies to all new work, also to any change made in old work. Parties who have made contracts for wiring calling for underwriters' wire, which contracts will not be completed before March 1, 1889, must send a written notice to the electrical inspector of the Boston Fire Underwriters' union. If such notice is not given, the work will not be approved under any circumstances. Any contract made subsequent to this notice, and not strictly complying with these rules, will not be approved.

"At a meeting of the Underwriters' committee, held Jan. 25, 1889, it was voted that on and after May 1, 1889, all electric lighting and wiring companies' men, who are in any way responsible for any of the wiring, running of dynamos, or care and management of batteries for electric lighting, must hold a license from the New England Electric exchange. This rule applies to isolated plants and central stations alike, and is imperative. No exception to it will be made.

"OSBORNE HOWES, JR.,
'Secretary."

I read this to you to show how harmonious are our relations now, that a year ago seemed to be antagonistic. The plan of licensing has further been approved since by the legislature, who have incorporated this exchange and given it power to grant licenses. In order to promote ambition in excellence of workmanship and to extend the knowledge among men practically engaged in installing and operating electrical plants, and thus make it an object for fire underwriters to recommend the introduction of electricity in preference to other means of producing artificial light and power, the New England Electric exchange will issue licenses of five classes, each class representing a certain extent of qualification. First-class licenses are issued only to persons fully competent to install and operate any electric light or electric power plant. The applicant for a first class license must be able to make working plans for central stations and for isolated installations, must have a general knowledge of the construction of dynamo electric machines and the electrical appliances necessary for electric light and electric power installations, a general knowledge of the principles, construction and installation of secondary or storage batteries, a thorough knowledge of the insurance rules pertaining to the business, a specific knowledge of the system operated by the applicant, and a thorough knowledge of the calculations necessary for and the rules governing electric wiring, and be able to make complete wiring plans. From this class we go down to those requiring less and less knowledge to men who are not competent to do the electric work. Fifth class licenses are issued to persons competent only to operate electric machinery, and who are not competent to do electric wiring. The applicant for a fifth class license must have a general knowledge of the operation of the particular electric light or electric power machinery it is desired to operate, and a thorough knowledge of the insurance rules pertaining thereto. You can readily see what great difficulty we have to examine these different men all over the New England states. We [illegible]

[illegible] seventy [illegible] [illegible] [illegible] forty [illegible] who [illegible] [illegible] [illegible]. But [illegible] quite attached [illegible] [illegible] [illegible] from saying. We simply [illegible] [illegible] again. They have a right to [illegible] [illegible] examination. They have [illegible] the second examination a great deal more knowledge than they ever had, putting [illegible] now, having something to look forward to [illegible] tain. They have done very well, [illegible] well, and the men themselves [illegible]. After the examiners have gone through [illegible] their minutes of the examination they send [illegible] port to the board of directors, who [illegible] carefully and either send the report [illegible] accordance with rules laid down [illegible]. Before issuing these licenses [illegible] to sign the certificate that is issued. The president and secretary have to sign the certificate, [illegible] once more we send it to the insurance inspector of that district, who comes in personal contact with these men, and who can tell us if, while they may have a knowledge of the business, they may be careless in carrying out their work. We have also a clause by which we can revoke any license that has been given to a man who proves incompetent afterward or careless in his work. We have found that men perfectly able to operate electric machinery are incompetent by reason of neglect and carelessness. Now, your resolution last summer asked this committee to recommend to the National Electric Light association what means should be taken to attain the same object. I have given this matter thought only a couple of days, but I cannot see how the National Electric association can establish a plan unless they divide the United States up into sub districts or recommend state organizations, that is, work hand in hand with the insurance people, or if you please independent of it, for I think in New England the electric exchange now would get along without insurance examiners, and I have predicted to some of my friends, insurance examiners who are here from New England, that the time will come when insurance companies in New England will not require an examination; they will only require this certificate of the foreman in charge of that work as a guarantee that the work has been done well. I want to say before I sit down that Mr. Barton's paper this morning, as well as the remarks I have made, would probably be best supplemented if the president would grant the New England insurance inspectors who are present here, but not members, the privilege of the floor.

THE CHAIRMAN. We shall be glad to hear from Capt. Brophy.

CAPT. BROPHY. If the New England Electric exchange fulfills its promise half as well as I hope it will, the office of insurance inspector will be no longer necessary. That individual will happily lay down his cares and tribulations, and seek other fields for the exercise of his powers. The insurance people of New England [illegible] have taken a more intelligent view of the electric light matter than most any other body of insurance men throughout the United States. There is no antagonism between the two bodies, but the insurance men stand [illegible] of enlightenment in regard to [illegible] [illegible] lighting. It is now too late for me to [illegible] recognizes that the electric light is the best [illegible] and illumination known at the present [illegible] gentlemen to prove to the masses of people [illegible] that it is also the safest. That [illegible] and that now the various companies—[illegible] companies and electric light companies [illegible] [illegible] insurance inspector [illegible] [illegible]. When we have competent men [illegible] New England [illegible] their work as they ought [illegible] paper [illegible] day [illegible] [illegible] that the [illegible] [illegible] [illegible]. We [illegible] [illegible] throughout [illegible] [illegible] in New England [illegible] [illegible] [illegible] New [illegible] insurance [illegible] the best people [illegible] in the best companies. In New England we have had

scarcely any loss to speak of when the amount of property invested in electric light stations is taken into consideration. [illegible] with the fact, I suppose, that they [illegible] of that territory. We have [illegible] a schedule of rating for electric light companies, and I trust that this organization will assist us a little. I hope if they have any suggestions before that is promulgated, that they will make them [illegible] that when you comply with the requirements of specification in [illegible] rating you will get what you have not been able to secure yet, a fair share of insurance and at the lowest rates. If you choose to deviate from that, you will have to pay for it. The moral hazard that is attached to a great many other kinds of business fortunately does not exist in this. You are under the contract to deliver a certain article, you must deliver it every day in the year, there is no motive whatever for the electric light companies to saddle off their property on the insurance people, and when the insurance people understand this thoroughly and many other things that we ought to know, I think there will be no friction—certainly not in our section of the country, and we hope to educate those in other sections up to our standard. The matter of insulation I hoped would have been settled in a little different way here from what it has been, but as the insurance exchange of New England is under no obligations to any one, maker of wire, or anybody else, we will take the bull by the horns ourselves and settle it so far as we are concerned in our section. All now that is required of you gentlemen is to do what you know how to do, and see that it is done—to make fires caused by electric lights or electric light wires so scarce that they will hardly ever be heard of. I wish to correct one statement made here yesterday which should not go abroad because it is not strictly proved. It was true that a little while ago the insurance people of Boston were somewhat agitated over the frequency, as they thought, of small fires in that city, caused, or said to be caused, by electric light wires, or by electric lights. I regret to say that this feeling in the breasts of insurance men was largely engendered by electric light men themselves. It will not do for you to run down or decry your opponents or competitors, as it will appear to the average insurance man that all systems of electric lighting are unsafe. Bear in mind that when you make them believe that one system, because it is not the one that you are dealing in, is unsafe, they naturally conclude that the same rule applies to all. Now, that was fomented in that way. It was stated here that every one of these fires was caused by underground wires. That is not true. The fires in New England, unfrequent as they have been, have not been confined to any one particular system of electric lighting; they are equally distributed among different kinds, or among different systems, but happily they have been so few that very little or few losses have had to be paid. We have had since the introduction of electric lighting in New England four electric light stations burned; two of them from causes entirely separated from the business carried on in them. Two might possibly have been traced to electrical causes, and each one might have been prevented by a reasonable amount of forethought. When you take into consideration the amount of money invested in New England—over ten million dollars, I think—in electric light stations, that is but a very small amount, and if any other section of the country does as well, I should be glad to hear from it. Now, the New England Insurance exchange takes a little credit to itself for the existence of this state of affairs there; but without the active co-operation of the men in the business their efforts would be fruitless. I wish to say here that we have met and received that co-operation and are doing it to-day. All we want now is for the electric exchange to give us the suitable men and furnish them with new qualifications, and perhaps in a few years hence I shall not be called an inspector for the New England Insurance exchange.

Mr. Killicut, Boston: I do not think that I [illegible] to what Mr. Brophy has already [illegible] I [illegible] sentiment which he has already expressed, and I think as most likely all of you do, that better insulation and construction will take away a great [illegible] the minds of a great many insurance [illegible] of the whole community at [illegible] which we are trying [illegible] New England [illegible] clear of any calamity which might befall the community, and, as [illegible] made here yes[illegible] regard the fires which [illegible] statement which was [illegible] I am the inspector for [illegible] We [illegible] Brophy says, in reporting which [illegible]

ance p[illegible]

ground system comes along we shall only be too glad to have it put in.

On motion of Mr. Morrison, the report of the committee on New England Electric exchange was accepted, and the committee continued. The thanks of this convention were extended to Capt. Brophy and Mr. Killicut.

The Chairman: The next in order will be the paper of C. H. Rudd, on "Disruptive Discharges in Lead Cables."

Disruptive Discharges in Lead Cables

BY C. H. RUDD.

In coming before the association at this time with the subject named, my principal object is to consider the experiments of A. G. Acheson. An account of these experiments appeared July 7, 1888, and was enlarged upon by Mr. Acheson at your last meeting. The results of the investigations suggested two conclusions: First, that the static capacity of a cable is a transforming agency by which a passing current might develop a static charge of greater electromotive force than the electromotive force which produces said current; second, that a static charge will not pass an arc. These conclusions are radical and cannot fail to attract attention. If they are sound they have a most important bearing upon cable service. By virtue of the first conclusion, we would be obliged to largely increase the value of cable insulation, or else put on high pressure protectors of a nature to carry a constant stream of sparks. And we would be obliged to ask, why have we not had a much greater number of burn-outs than we have? By virtue of the second conclusion, the high pressure protectors, if used, would have to go into every section of cable cut off from other sections by lamps. I do not believe these conclusions to be sound, and expect to [illegible] that [illegible] I question the first because it con[illegible] that the electromotive force [illegible] exceed the electromotive force of [illegible] well sustained in daily [illegible] If the results of an experi[illegible] established principle [illegible]

[illegible] the experiment from which the first [illegible] copy of [illegible] alternating dynamo, [illegible] of the [illegible] switch to aid in [illegible] X is a switch with which to break the secondary circuit. X is a switch with which to break the primary circuit. C and D are posts supporting points A and B. The distance between points A and B is adjusted by means of pointer P and scale S. F is a piece of fusible wire for safety. K is a condenser. Now, let us suppose condenser K to be disconnected for a moment. It was in that form that the first step was taken. We are told that by rupturing the circuit at E, sparks were obtained between A, B of various lengths according to the position of switch R. This is plainly impossible. To open switch E is but another form of increasing the distance between A, B, and we know that such increase would not cause a spark at A, B. I do not deny that sparks were obtained in the experiment, but I do deny that sparking conditions are shown in this diagram. There are no explanations offered by which the sparking conditions can be understood, and explanations would be valueless in this case, for if the sparks occur in any roundabout way the experiment becomes simply an electrical puzzle without bearing upon the subject under consideration. The investigator seems to assume that everybody will agree that ruptures of circuit and sparks are inseparable. This assumption is without support. When ruptures produce sparks it is because accompanying conditions are favorable, for instance: If a closed circuit is relieving two points of electrical strain (see points A, B, Fig. 2) and the circuit should be ruptured, say, at E, points A, B would have to bear the strain and a spark might pass between them. We do not find such tendencies to spark in the work shown. From the nature of the investigation it is manifest that the first step in the experiment should have been to produce sparking conditions such that the sparks would depend on pressure only, after which the effect of adding condenser capacity could have been properly observed. Inasmuch, then, as the experiment shown to us lacks the vital element necessary to make it demonstrative, every deduction made from said experiment must fall to the ground. The subject under investigation by Mr. Acheson is treated of by Gordon under the head of secondary condensers. A secondary condenser (see Fig. 3) is said to add to the burning power of a spark. If Mr. Acheson had made a proper series of experiments in the laboratory and had then desired to carry his work over into practical life, he would have first obtained a cable carrying heavy current, the cable having in it a spot so weak that the direct pressure was able to break through. In such a case he would have sparking points around which he might connect his secondary condenser, and ob[illegible]

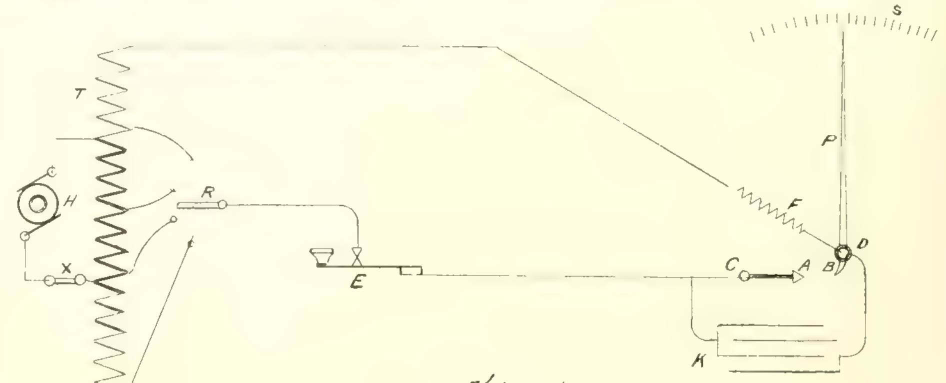

Fig 1

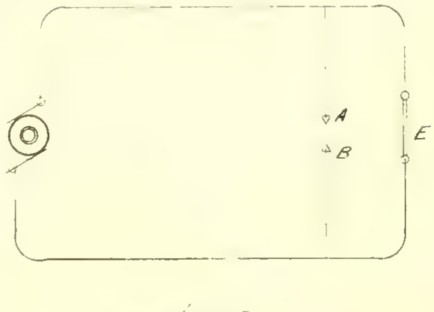

Fig 2.

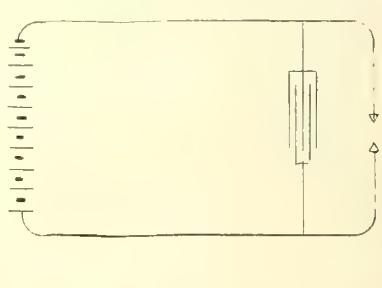

Fig 3

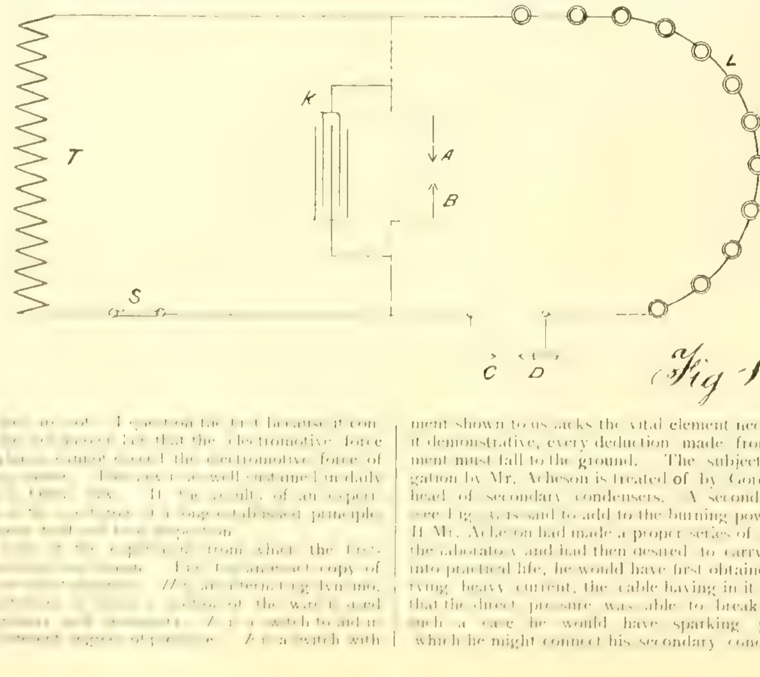

Fig 4

serve its effect upon the burning power of the spark. He would, however, require some sort of electrical microscope with which to make his observations. That any ordinary method of noting the effect of a condenser upon the spark which I have described would be of no value, is manifest when we consider that a condenser of one microfarad charged to a voltage of twenty-five hundred would hold .0025 coulombs. A current of one ampere carries one coulomb per second. As it is coulombs which determine the destructive power of a spark, it is plain that when direct pressure begins to break through a weak spot in the cable, the addition to its destroying power, which it receives from the condenser capacity of the cable, is extremely insignificant. To sum up my position concerning Mr. Acheson's first conclusion, I will say that the static charge in an ordinary cable is a negligible quantity when compared with the regular current flowing, and the electromotive force of said charge cannot be greater than the electromotive force of the current from which it was derived. Therefore, in considering the character and thickness of insulation, we have nothing to take account of but the primary pressure which bears upon the insulation. Mr. Acheson's second conclusion, viz., that a static charge will not pass an arc, virtually

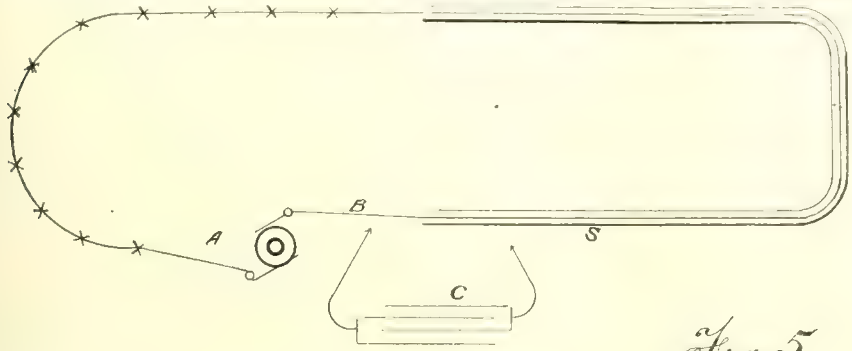

Fig 5.

declares an arc circuit to exist as a number of sections in a sense insulated from each other, and in that connection the statement is made that each separate section comes under separate strain every time that the circuit is shut down. I think that I have already satisfied you that we may hold our old ideas concerning the electromotive force of a static charge, therefore we need not fear that an imprisoned charge would do any more harm that the current did from which it came. If we charge an ordinary condenser from a battery, and the condenser does not break down, we do not apprehend that the condenser will break down when we disconnect the battery. There is in the minds of some people an idea that static electricity when it begins to move produces a current possessing different properties from currents formed by other electricity under the same conditions. This idea is unsupported and need not be entertained seriously.

But let us see how Mr. Acheson proves that a static charge will not pass an arc. In Fig. 4 *T* is a transformer yielding 2,067 volts, *S* is a break switch, *K* is a condenser,

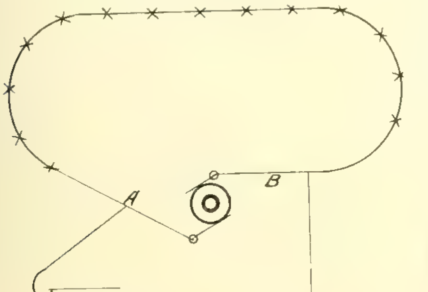

Fig. 6

A, *B* sparking points, *C*, *D* adjustable points so arranged as to be readily placed in contact, *L* a circuit of twenty incandescent lamps in series measuring perhaps 4,000 ohms all told. Mr. Acheson says that when contact was made between *C*, *D* no amount of rupturing circuit at *S* could cause a spark at *A*, *B*, but when he opened points *C*, *D*, and produced an arc there, then rupturing circuit at *S* produced a heavy spark at *A*, *B*. From this the conclusion is drawn that the arc is an effectual barrier to the passage of static charge. Let us see. If we have an arc burning at *C*, *D* it would expire simultaneously with the arc which would form at *S* when *S* is opened. Therefore the retardation spoken of by Mr. Acheson was due to the break at *C*, *D*, and not to the arc at all, the arc having expired before the observation on retardation was made. To sum up my position as regards the second conclusion, it is evident that the arc affords free passage to ordinary currents, and we have nothing to indicate as yet that the arc makes distinction between the static charge in motion and other electricity in motion. It is also evident that the insulation of a cable does not undergo strain at shutting down due to the static charge. Mr. Smith referred at the last meeting to some sparks observed when an arc circuit was shut down. These sparks may be readily ascribed to magnetic discharge from the lamps.

I will now speak of an experiment in which I assisted last summer. The experiment [illegible] described [illegible] feet of [illegible] covered cable was laid out upon [illegible] the floor. The cable was connected [illegible] ing circuit. When first connected up [illegible] be strongly charged by placing it in [illegible] *B*, Fig. [illegible]. At first sight it seemed that Mr. [illegible] position was confirmed. An attempt to repeat [illegible] ment on the following day resulted in [illegible] attempt on the third day succeeded. [illegible] of the proceedings [illegible] examination, I [illegible] ent working circuits had been used each day. [illegible] idea in the experiment was that if a current would create a static charge of a nature unlike said current [illegible] should be [illegible] from any working circuit. When I learned the conditions of the various experiments, I [illegible] my belief that the results obtained were of the [illegible] monplace nature, and requested that the steps in the experiment be repeated. This was done. We [illegible] when we put the extra cable into a circuit [illegible] cover scarcely a sign of charge could be seen in condenser *C*, but upon plugging into a circuit exposed to the weather, a definite charge was obtained. We then [illegible] covered circuit. Results were same as before, viz.: no charge. We then put a ground at *B*. This gave us a strong charge. We then began to observe the polarity of charge, and found that we could reverse the polarity by putting the loop in at *A*, and the ground at *B*. This change removed all ideas that the results obtained were out of the ordinary, and let us square down upon the common principles of everyday life. The shield *S* was a ground of some value, so we concluded that we had been trying to see if we could get a charge out of a working dynamo by connecting a condenser between *A* and the ground with a ground at *B*, and again if we could change the polarity of the charge by putting the condenser between *B* and ground with ground at *A*, Fig. 6. A rather simple experiment when stripped of its useless features.

In conclusion, I will say that if disruptive discharges occur in properly insulated cables, we must look for the cause in those sources of high pressure which exist in nature. I do not believe that burn outs can be ascribed to any one cause, but that each individual case has its own individual cause. In practice we must provide insulation strong enough to meet the daily strain, and suitable devices to prevent the accumulation of charge from outside sources of greater pressure than the insulation will bear. As yet we have no proof that high pressure protectors are required anywhere outside of the station from which the wires start. Mr. Acheson says that the greater number of grounds or burn-outs occurring on arc light circuits are at the terminals of the lead or at the joints, and says that such a state of things would be naturally caused by the greater density of the static charges at these points. This statement strikes me as a singular carrying over of ideas obtained in laboratory work with purely static electricity and arbitrarily applying them to entirely different conditions. The natural static charge in a cable, due to the distribution of the working electromotive force of the current in the cable, must necessarily be governed in its distribution by the force from which it originated. The shape of the conductor cannot act in the matter of this kind of static distribution, as the shape of an insulated conductor would act upon a purely static charge. This remark of mine about distribution may not be treated of by any of the men who write books, but I confidently appeal to my hearers for support. As regards burn-outs occurring at terminals and joints, we know that great care is required to make these points equal to the rest of the cable in matter of insulation. I do not see how it can be known that burn-outs at such places are not due to accident in construction or actual neglect on the part of the workmen.

THE CHAIRMAN: The paper of Mr. Rudd is before you for discussion.

MR. BARRETT: I would like to ask Mr. Rudd a question. I understood him to say that the disruptions were determined by the thickness of the insulation.

MR. RUDD: I made the remark that if the insulation was too thin to bear the direct pressure the static capacity would have no effect upon it.

PROF. BARRETT: What I want to ask you is how to determine about the thickness of the insulation to fit any proportionate amount of pressure.

MR. RUDD: I did not intend to bear upon that point. I have endeavored in this paper to merely make as plain as I could the general principles involved in the discharge of the current through a cable having some capacity. I did not intend to bring up the subject as to what thickness the insulation would be required to meet any given pressure.

MR. LOCKWOOD: What becomes of the magnetism of the magnetic charge of the fields?

MR. RUDD: It is obliged then to look for some other outlet.

[illegible] In [illegible] uit from the m[illegible] the [illegible]

MR. [illegible] If [illegible] don't see how that could make any trouble if the insulation was good under normal conditions.

MR. [illegible]: It [illegible] weak point might [illegible]. A [illegible] large current safely if the circuit was closed, would be broken down immediately if the circuit was open.

MR. L[illegible]: What if the ground [illegible] circuit was at one extreme, with no lamps between itself and the dynamo, and the lead covered cable at the other side was at the other extreme?

MR RUDD: We have a ground, say here [referring to the diagram] right next to the dynamo. We [illegible] here [indicating]

MR. LOCKWOOD: And we have [illegible] where your condenser is the lead cable. The break will be right in the center, say the central lamp for instance. Now under normal conditions between those two points, a ground on one side and lead covered cable acting as a condenser on the other, wouldn't it have the full potential of the circuit?

MR. RUDD: Do you suppose here is the ground [indicating], here is a condenser; here you make a break.

MR LOCKWOOD: Under normal conditions would that not be getting the full potential of the circuit?

MR. RUDD: No; the maximum of the lamp would be cut off.

MR. LOCKWOOD: But between those two points would not the maximum electromotive force of the circuit be found?

MR. RUDD: That would depend somewhat on the resistance of the circuit.

MR. LOCKWOOD: Suppose there is no resistance practically between those points and the dynamo.

MR. RUDD: Well that would depend on the resistance of the circuit. If the resistance of the circuit was equal to the resistance of the dynamo you would get one-half pressure.

MR. LOCKWOOD: If there is one-half the pressure, what would you get?

MR. RUDD: You would get some extra current from the lamps

MR. LOCKWOOD: Say 1,250, under the conditions of the lamps all running, half being in the dynamo and in the armature.

MR RUDD: Where would that extra electromotive force come from?

MR. LOCKWOOD: I am not stating anything. I am asking for information.

MR. RUDD: I can answer you better if you tell me where that comes from. Where is the source? Here we have the ground; here you cut off the circuit [indicating].

MR. LOCKWOOD: My idea was that the full magnetic force of the dynamo would discharge itself in what might be called the induced current, and I want to know whether the induced current was of higher electromotive force.

MR. RUDD: An induced current is always of higher electromotor force than the inducing current

MR. ACHESON: I have been exceedingly pleased in listening to this paper. The gentleman has given me much pleasure by the paper he has prepared, owing greatly to the fact that my original experimental work was [illegible] with the object of eliciting replies and drawing [illegible] this work —a work that must be done by somebody, and a work that I have but few facilities for doing. It was only partly done, and in fact only begun, at the time of the convention in New York, and I there presented the [illegible] portion that I had prepared, and since then I have been continuing the subject in a limited way, as a great deal of work has occupied my attention. But I have here a few notes of some work that I have done during the last week. There were two questions, I believe, which Mr Rudd said that the matter [illegible] I was demonstrating or had discovered a new principle or else it was all wrong. I do not think I discovered a new principle and I do not think it is all wrong, but he seems to think that I have assumed [illegible] energy owing to the existence of the cable [illegible] energy that is formed or produced owing to the existence of the cable. That is not exactly the case. We have though, owing to the fact that the cable is there, [illegible] energy on hand that is not contained in the [illegible] current and it is that that produces our discharge [illegible] following that up in a very limited way I [illegible] from experiments that the time necessary for the formation of an induced current [illegible] the induced current being a secondary [illegible] hundred thousandth part of a second; that a current is

[illegible] sufficient energy and more than sufficient to produce a spark. The time necessary for the spark is [illegible] part of one second. Now we [illegible] energy contained in or represented by [illegible] two hundred feet of a No. [illegible] Brown & Sharpe [illegible] conductor, when conveying [illegible] two amperes. That will have for each [illegible] under that wire, an energy [illegible] and two-tenths joules, and the amount of energy that may be withdrawn from such a conductor under such conditions in the space of twenty-five hundred thousandth [illegible] occupied by the induced current [illegible] hundred thousands of a joule. Now [illegible] withdrawn in an interval [illegible] equal to twenty-five hundred-thousandths of a second [illegible] tenths of a joule. Now the energy contained in the same sized cable under similar conditions and operated by two thousand volts of [illegible] the energy there will be equal to four one-hundredths of a joule, or about twenty times the amount of energy that can be withdrawn from the same length of cable owing to the existence of a [illegible] in the cable. Mr. Rudd assumes that I have supposed an increase of energy or a building up. It is a building up, or rather it is a condensation [illegible] owing to that capacity, and it enables us to do about twenty times that work. Some experiments I made were in relation to the time necessary of a discharge of the more remote parts of the cable. I wanted to learn how the distance from the terminal would effect this discharge, and although I have lost my notes, I have roughly jotted down some of the data from memory. My experiments were made with wire number 18, Brown & Sharpe. There were fifteen feet of wire through which I could discharge a current that was held in a jar having a capacity of twenty-five ten-thousandths of a microfarad and charged up to its potential, so that it would discharge through two hundred and eighty-six thousandths of an inch. With that amount of energy discharged through that wire I produced an induced current in a parallel wire and used that as a means of determining the time or rather the rapidity of change in the inducing current affecting directly the electromotive force in the parallel wire. With a wire ten feet long my parallel wire was about five feet in length. I could get a discharge between the terminals of the terminal wire of one hundred and fifty thousandths of an inch. As that wire lengthened to twenty-five feet the discharge became about seventy-five thousandths of an inch. I have forgotten exactly [illegible] it fell to about forty thousandths at one hundred feet. From there on the curve flattened out, and at two hundred feet it had not dropped probably below thirty-five thousandths. Now, from this I rather argue that the first one hundred to one hundred and fifty feet is the portion of the cable that is going to effect this discharge. The other portions beyond that cannot deliver their energy with sufficient rapidity. It shows the necessity of the energy being delivered instantly, in a time far beyond any measurement of ours in the eight [illegible] of a second. Now, if Mr. Rudd will kindly permit me to use his diagram, I would like to say something further. This is the diagram showing the apparatus first used to determine the electromotive forces of these various sections of the conductor, [illegible] required electromotive force with any [illegible] capacity for this discharge. Now, as I stated, my experiments at this day were hardly [illegible]. I have not yet learned the true cause of this, [illegible] the necessity of explaining it does not [illegible]. I [illegible] think, from the existence of the [illegible]. They [illegible] exist, regardless of the fact of any [illegible] then I, at that time, did not [illegible] afterward has been [illegible]. The length of this wire [illegible] a few inches. I [illegible]. In fact I did not at [illegible] the necessity of measuring them. [illegible] perhaps four or five feet. Now I [illegible] feet of wire lying parallel to [illegible] current sufficient to [illegible] one-hundredths of an inch. [illegible] current induced in a parallel wire [illegible] induced in a primary, in case the [illegible]. The current in the primary is the [illegible] so that when we open this, we [illegible] condenser and on opening [illegible] and the condenser [illegible]. It will induce [illegible] opening here [indicating] [illegible] this point that will [illegible]. There is [illegible] possible explanation [illegible] true. It [illegible] with me. I am not [illegible] the resistance of [illegible].

[illegible] M[illegible] the existence [illegible]. He referred to the fact th[illegible] distance [illegible] the [illegible]

[illegible]

with the expectation of not getting it, I still found it in the circuit.

Mr. Rudd: I would say right here that I took the ground that it capacity was not necessary to make the spark plain, the capacity then was a primary condition and not merely an auxiliary condition, and I understood that you examined the auxiliary effect of condensers, or the effect of the condenser upon disruptive discharge. Where a tendency to discharge already exists you desired to find out how much that was increased by the presence of the condenser.

Mr. Acheson: Of the condenser and of the energy it delivers at the disposal of the work to be done. In the paper read in New York I believe I stated that there was no time for the generation of a current in the dynamo. You had to have it on hand. As I have shown here the actual energy transmitted over your wire is but a fraction of that on hand, owing to the existence of your cable and its capacity, it is a thing you must have there to do the work with. The current passing over the wire is not sufficient to generate it.

But referring to this diagram here, Mr. Rudd simply stated the case very clearly, as I explained, I believe, from the fact that when there is a spark here, we get a spark there [indicating]. If it was understood that I stated that it was owing to the actual existence of the arc, which I may have done without intentionally doing so, I wanted to have it understood that it was due to the fact of the arcs having existed, or existing, as the case might be. It was either due to the fact of their existing and preventing the discharge passing through the arc or to the fact that they ceased to exist and there wasn't time for the circuit to close, leaving an open space prohibiting the discharge from passing in there, and consequently it passed here [indicating].

Now, I would like to state here that while I was in the early stages of these experiments, I thought that I had already at that time obtained results of value to those who were interested in underground work, and that they would be benefited by knowing of these results and profiting by them. An invitation was sent to a gentleman interested in underground matters very extensively, to come and see these experiments, in order that he personally might profit by them. That gentleman returned to his home and introduced the subject to various others, and they entered the experimental field with a decided desire, as has since developed, to obtain results contrary to those which I had obtained, and which had been offered to him gratuitously for his special benefit. This work is some of the results of it, and this is one of the experiments made at that time [referring to the diagram]. Here we have a piece of cable placed in our circuit. The experimenters have taken a condenser and connected one of the terminals to the line wire. The statement was not made as to distance between the end of this cable and the point on the line where this terminal was connected. But having done this, they obtained a spark on making a contact with the terminal and the cable, which would not surprise them, provided the distance between these points was of any value. After doing this they connected the ends and got a discharge that certainly would not have produced the beliefs or theories that I had formed. There will under certain conditions be a different value obtained, as was shown by the fact that when the cable was dry they could not get a charge of much value. When it got wet they did get a charge of more value. When it got wet, this cable, instead of remaining a conductor simply parallel to the line wire, became more or less grounded throughout its entire length and in place of getting your potential at any point here which is produced by the line wire, that point would be removed a certain distance. But, however that might be, your charge could be of any value governed by the distance you would carry your point back toward the machine.

Mr. Rudd. It was two or three inches.

Mr. Acheson: Then it would be dependent on that, and your grounding of the cable would throw that point back still farther.

Mr. Rudd: If you will pardon me, I think it carried it to the other side of the dynamo.

Mr. Acheson: Then you would get the entire charge of your machine in it.

Mr. Rudd. We got a very decided charge, considering the resistance of the field.

Mr. Acheson: That diagram [indicating] is this one changed in its connections, and neither of them has any relation whatever to determining the value of a discharge, owing to the current condensed in the cable. In your first two hundred feet of cable, the interval of time necessary for your current to be delivered and discharged to your terminal is greater than that occupied by your spark. But then, in your first two hundred feet your energy is of greater value than that obtained in the dynamic current in a similar range of wire.

Dr. Mo[illegible]: Can Mr. Acheson explain to the convention some of the arrangements by which he determines the relative value of the static discharge in the conductor? I simply ask in order that we may be approximately able to assume that your observations are correct. You spoke of a rather sharp fall in a distance of fifty or sixty feet. Some little explanation perhaps of the manner in which it was obtained would give a clearer idea of the matter.

Mr. Acheson: The real facts are that these experiments are going to be of a quite extensive character and I am reserving them for future use [applause].

The President: I desire to take the opportunity now of tendering [illegible] to our new president, Mr. [illegible] Weeks [illegible] Kansas City [applause].

Mr. Weeks: I [illegible] too deeply sensible of the high [illegible] confidence [illegible] upon me to fail to doubt [illegible] Although my home is very [illegible] one thousand miles [illegible] the United States. In [illegible] that you have many members [illegible] the office of president of this association. I take your action in large part as a recognition of the great west, as a recognition of the sleepless enterprise and indomitable pluck that is rapidly converting the Great American desert into green pastures, blooming orchards and fields of golden grain, and which have transformed a vast swamp into one of the world's greatest and most beautiful cities. This association now enters upon its fifth year and while much has been accomplished under the able leaderships of Mr. Duncan and Mr. Morrison, infinitely more remains to be done. The electrical industries lead the van of human progress. In the highest sense of the word the electrical engineer of to-day is the resultant of all engineering experience, and to the engineers of the world more than to all other professions the civilization of the present age is due. Let us remember our high calling and with one accord strive to advance the National Electric Light association to a still higher place among the world's industrial and scientific societies. Gentlemen, in accepting the trust which you have placed in my hands I ask you to give me your counsel, your sympathy and your most hearty support [applause].

Mr. DeCamp. I would like to offer a resolution which I will ask the secretary to read.

The secretary read the resolution as follows:

"Whereas, In no state, so far as can be ascertained, are the laws properly drawn to enable municipalities to contract with incorporated companies to perform services for cities and their citizens upon a sound economical basis; be it

"Resolved, That a committee on state and municipal legislation be appointed, consisting of one member from each state, to operate together, to secure such legislation in each state as may be required to enable municipalities to contract with incorporated companies to perform services for cities and their citizens, on the sound economical basis of securing to such companies an undivided demand, an unrestricted privilege and a permanent investment."

Mr. DeCamp. Mr. Chairman, I want to say that that is a resolution that was framed by A. R. Foote of Cincinnati, and he gave it to me to read, saying that he was going to offer it. I advised him to offer it. He wanted me to read it, but I saw the opportunity of offering it and I did so.

The resolution was adopted.

Mr. Mason. This calls for the appointment of a committee of one from each city. I move that that be referred to the executive committee.

The motion was carried.

The President: We will now hear from S. S. Leonard upon petroleum as a fuel.

Mr. Leonard read the following paper:

Fuel Oil.

BY S. S. LEONARD.

In presenting this second paper on fuel oil, I do so with some hesitancy; not that I have less faith in its use, but because I have not the data that I would like to have in bringing the subject before this association again.

During the past few months I have endeavored to obtain what information I could upon this subject from those who have been using oil, and especially from any electric light companies. The general experience does not seem to be very favorable, and I have been advised to have nothing to do with it; that the saving by its use over other fuels, if any, was more than counterbalanced by its injurious effect upon both boilers and furnaces; that the fire risk was greatly increased, and it would be found very difficult to place insurance upon our plant. One gentleman wrote me they had just had a serious fire in their station, which could be clearly traced to the use of oil, and then kindly offered to sell me their outfit of burners, pumps, etc., very cheap, should I desire to find out for myself, what they already knew, that oil was a failure. Others found that the use of oil was injuring their boilers by burning out the flues, they being compelled to put in new ones after a few months' use; some reported that it was almost impossible to keep their furnaces in repair, as the intense heat seemed to melt the fire brick, necessitating the rebuilding in part of the furnace after a short use; this was somewhat expensive, and amounted to more than was saved by the use of oil, so the oil was abandoned. As I read over these various experiences it carried me back to the time when we were going through the same trouble. Although we never injured our boilers, we did burn up a great many fire brick, and were obliged to rebuild our furnaces several times. Previous to our experimenting with oil, I had occasion to visit the east, and saw for the first time natural gas in use. I was strongly impressed with its many advantages, and when fuel oil was first mentioned to me I thought I saw in it a substitute for natural gas. We were assured it was not necessary to alter our furnaces any, only cover the grate bars with fire brick so the heat would not injure them, put in the burner, turn on the oil, light it, and "let her go." It seemed so simple, and could be done so easily and with so little expense, that I was delighted; but, alas, my expectations were not to be so easily realized. It was very evident fuel oil was not a success under the conditions with which we were using it. The oil was not all burned, and ran down into the ash pits, where, after awhile, it was set on fire and consumed, everything was dirty and the odor was far from agreeable. Notwithstanding all this, we still had some faith, and kept at it, and are now convinced that to make a success of burning oil for steam purposes it is as essential to have the proper settings or furnaces as it is to have a boiler to make steam.

We have been using oil for about eighteen months, and for the last [illegible] months exclusively under our seven boilers. The boilers are [illegible] inches, with forty-four four-inch flues. During the first part of the night these boilers are all in use, furnishing steam to four Reynolds-Corliss condensing engines, from which we are using about 1,100 horse power. The steam pressure is easily maintained at any desired point, usually with us at 100 pounds. Our

arrangement for the handling and storage of this oil I described in my former paper, and I only wish to add that so far it has worked admirably.

In speaking of the economy from the labor side, I made the statement that one man could attend to from seven to ten 150 horse power boilers, which I am now positive of, as we have but one fireman at night and one during the day, while when using coal we had three men at night, and three or four during the day. It kept two men busy half a day wheeling out the ashes, and the other half was occupied in getting in the coal, and it was as much as one man could do to keep the flues clean. Now there are no ashes to cart out and no coal to cart in. Our flues are cleaned out once a week, and from the whole seven boilers there is not as much dirt as from one boiler with one night's run on coal. I am frequently asked if the burning of oil does not injure the boilers. A short time since the inspector of the Hartford Steam Boiler Insurance company made a very thorough inspection of our boilers. This same inspector had examined them a number of times when we were using coal, and was familiar with their condition previous to the introduction of oil; in reply to my question, "Did you discover anything wrong?" he replied that he thought they were in better condition than when we were using coal. Our engineer has also examined them very carefully, and up to the present time has been unable to discover any evil effects from its use, so that from the length of time we have been using oil, and as no injury is apparent, I feel warranted in saying that the proper use of fuel oil will not injure a boiler. Improperly used, and by this I mean where the flame is allowed to strike the shell in any one spot continuously, it will soon damage a boiler, and the harder it strikes the sooner the damage; but this is true of any fire, whether it be coal, wood or gas; for, if the fire is blown against the shell as an oil fire is blown, it is only a question of time, and that not long, when the effect will be very apparent. By the proper adjustment of the burner this trouble can all be obviated, and the flame carried beneath the boiler, not up against it. I have already mentioned the expense of keeping in repair the settings or furnace as experienced by some who have used oil; this should not be, and is all wrong. We have furnaces that have been in use over a year, and they are in as good condition as when first built, and, as far as I can see, will last for a long time yet. Oil is very much easier on them than coal, is what our experience teaches. In reference to the burner, I would say that its requirements are few, but they are absolutely necessary to complete the success of using oil. It should be so made that it can be easily taken apart for cleaning when necessary; the oil should be all consumed that passes through it, whether the fire be a slow one or the burner pushed to its utmost capacity; it should not smoke, but produce a clear, bright fire. When our seven boilers are going full blast not a particle of smoke can be seen issuing from the stack. The fire should be as near the front of the boiler as possible, and not half way back, as I have seen it with some burners, for with the latter you are losing a large part of the capacity of your boiler, while the former heats the water the full length of the boiler at the same cost. "Do you find it cheaper than coal?" is a question very familiar to me. Yes, we do find it cheaper than coal in Minneapolis, but whether it would be cheaper than coal anywhere I have my doubts, as it would depend altogether upon the cost and quality of the coal used. The best quality of Illinois lump coal costs us from $3.25 to $3.50 per ton, while eastern coals are worth from $4.50 to $5.50 per ton; I refer to bituminous coals. The oil costs at present 2½ cents a gallon delivered in Minneapolis. In comparing tests made by us with oil and coal, we find that 2½ barrels or 104 gallons, costing (at 2½ cents per gallon) $2.60, will evaporate as much water as one ton of coal that costs us $3.15, being a saving of about 21 per cent. in favor of the oil. With one pound of coal we evaporated 5.38 pounds of water; one ton of coal would, therefore, evaporate 10,760 pounds of water. With oil 14.8 pounds of water were evaporated per pound of oil. Oil weighs about seven pounds to the gallon, one gallon of oil would therefore evaporate 103.6 pounds of water. With oil at 2½ cents per gallon, it would take 126 gallons to cost the same as one ton of coal, viz., $3.15; 126 gallons of oil would evaporate 13,053 pounds of water, while one ton of coal evaporates 10,760 pounds of water, being a difference of 2,293 pounds in favor of the oil, or a saving of 21 per cent. When I consented to write this paper I fully expected to have tests made as to what we were actually doing now by indicating our engines, weighing the water and oil used, etc., but circumstances have been such as to make that impossible. I have, however, calculated from the number of lamps burning and motors running the amount of power we were using at present, and by doing the same thing when using coal I find that the percentage of increase in power used is considerably larger than the increase in cost of fuel, being about 15 per cent. Although I am fully aware that this way of figuring is not absolutely correct, still my figures thus obtained are so near the others mentioned that I feel they are not far out of the way, and that we are actually saving in fuel alone at least 15 per cent., if not 20.

My attention has been called several times to the fact that the amount of water evaporated by us, viz., 5.38 pounds per pound of coal was very low; that is true, but the quality of coal used was very low as well. I have made a few figures showing what would be required of coal at various prices to equal the cost of oil. With oil at 2½ cents per gallon, a ton of coal costing $3.50 must evaporate 7.25 pounds of water per pound of coal to equal cost of oil, or coal costing $4 per ton must evaporate 8.28 pounds of water, and a coal costing $5 would have to evaporate 10.36 pounds of water to cost no more than oil. Our experience has demonstrated that it takes a very good coal to evaporate 10 pounds of water per pound of coal, and that quality would be exceedingly cheap at $5 per ton with us.

Those of us who are interested in electric light plants know only too well how they are considered by insurance companies. I was once in the insurance business myself, and among the classifications of risks was one that was termed the moral risk. On this the rate was high, and [illegible] I can hardly believe that the underwriters look upon electric light plants as moral risks, not even if they use crude petroleum for fuel, still the rate is very high. We [illegible] had some difficulty in placing insurance on our plant, notwithstanding the fact that all of the insurance men who have inspected our system are agreed that they cannot see wherein the danger lies, or that the risk is any greater than it was with coal. When we first introduced fuel oil our insurance rate was raised from 1¼ to 2¼ per cent. At that time our arrangements for handling the oil were about as crude as the oil itself, and although we thought the rate exorbitant, we submitted, trusting that, should we finally adopt the oil for fuel, the insurance companies would restore the rate to about the old figures; but, no, it made no difference whether the arrangement was good or bad, the rate remained the same. Under certain conditions you are permitted to use oil without extra charge, but those conditions are almost prohibitory, especially if real estate is at all valuable in the vicinity of the plant. As, for instance, if you keep the oil in tanks 200 feet from your building above ground, or 100 feet if under ground, it can be used without extra cost, I believe. Some companies allow the tanks to be as near as 50 feet if under ground. I do not believe the danger lies entirely in the situation of the storage tanks—in fact, I think that has very little to do with it. There is no doubt in my mind but that the tanks should be under ground and so arranged that they can be got at, and should a fire occur in the building and it become necessary to shut off the supply of oil, it could be done at the tanks as well as in the building. It is the opinion of many insurance men that our building could burn to the ground and the oil in our tanks not be affected in the least, and our tanks are about 25 feet from the building, under ground. I do not mean to say that no restrictions should be put upon the use of fuel oil; there should be, by all means. It will burn and it makes a bad fire; but I do say where properly put in there is as little danger as from any other fuel used, and by properly, I not only mean the storage tanks, but the entire outfit, burners, piping, furnaces and all. What insurance companies ever thought of restricting the location of your coal sheds to 200 feet or even 50 feet from your building? Yet, we had more trouble from coal than we have ever had from oil; several times our coal sheds caught fire from spontaneous combustion; still a little thing like that did not trouble the insurance companies any, and there was nothing said about raising rates. I am of the opinion that the insurance companies will soon discover that they are making a great mistake in condemning the use of oil on general principles.

M. J. Francisco read the following paper upon the subject of "Liquid Fuel:"

Liquid Fuel.

BY M. J. FRANCISCO.

I have been requested by your secretary to bring before this association for discussion the subject of Liquid Fuel, with facts pro and con regarding the benefits to be derived from its use. Do not let the name mislead you. I do not refer to the liquid fuel that Dante saw, "which fed the fires in that abyss that Lucifer with Judas did engulf," but to the liquid fuel of the nineteenth century—petroleum oil.

At the present time we have no knowledge of any means of securing light without heat, and it only remains for us to employ the most economical fuel to produce the heat without useless waste. It has been asserted that the question of dividends in electric lighting lies between the shovel and the dynamo, and the fraternity have been taxed to their utmost to provide a plan for dispensing with the shovel entirely, and thus securing at least a part of the much coveted dividend. Petroleum, it is claimed, will furnish the substitute. Query, will it? One pound of coal contains 12,000 heat units, while one pound of petroleum furnishes 20,000. Another factor of vital importance is the power to vaporize water. Engineers of experience who are familiar with the practical workings of coal know that under the most favorable conditions not more than ten pounds of water can be vaporized per pound of coal, while petroleum shows a vaporization of eighteen pounds of water for every pound of oil consumed, estimating in both experiments the feed water at 212 degrees Fahrenheit. The heat in coal, transferable to water, is about 70 per cent., while the heat in petroleum, transferable to water, is about 80 per cent. Therefore with coal, 70 per cent. of 12,000 units gives 8,400, and for petroleum 80 per cent. of 20,000 is 16,000, a gain of 7,600 heat units in each pound. This is on the basis of pure coal; but when we consider the waste, amounting in some cases to 25 per cent., and the master mechanic of one of the largest railroads in the country claims 55 per cent., found in nearly all coal, such as sulphur, slate and earthy substances which are incombustible and retard instead of generating heat, the difference in the per cent. obtained in actual practice is far greater than shown by the above comparison. There is also in coal a large percentage of loss in transportation, and combustion in the heap, varying from 5 to 10 per cent. From these facts we can safely conclude that the heating capacity of oil is nearly twice that of coal as generally used.

On this basis the only question to be considered is the cost of power furnished by each at the dynamo. Three and one half barrels, or 955 pounds of oil, equal 2,240 pounds of pure coal, therefore with oil at $1 per barrel and coal $3.50 per ton, or oil at $1.50 per barrel, and coal $4.50, the difference in cost would not be so marked, if there were no other factors to be considered. When, however, we calculate the great saving in stoking, removing cinders and ashes, cleaning flues and benefit to boilers, besides securing a steady heat, combined with the quickness and ease in starting and shutting down, we have an argument in favor of oil that stockholders who care for dividends can appreciate. I have found, upon investigation, that oil can be delivered at my station for $1.05 per barrel, while soft coal costs $4.50 and hard $6 per ton. On this basis, allowing five pounds of coal per hour, twelve hours per day, 1,000 horse power requiring 803 tons per month [illegible] ning flues, etc., [illegible]

[illegible]

fuel is about the same. Though [illegible] in large quantities at one time and secure low rates [illegible] prefer liquid fuel, because it is clean and requi[illegible] man, and gives a better supply of steam. Day [illegible] Co. of Boston, claim that [illegible] per ton, and liquid fuel at $1.15 per barrel, they sa[illegible] cents per 100 horse power per hour [illegible] The Fairbanks Scale company at [illegible] find it a great saving over coal, while the boilers are he[illegible] evenly the entire length, also that the insurance companies have not increased their rates. T. F. [illegible] the Toledo, Columbus & Southern railway, reports a saving of 33 per cent. of the price of coal, by using liquid fuel, also that two barrels of oil equal one ton of soft coal, while manufacturers on his road find it only costs one-half as much as coal for their stationary boilers. The [illegible] mill works of this city, Chicago, use it under a battery of fourteen boilers, and say that three and six-tenths barrels of oil does the work of one ton of coal. The cost of oil is less than coal, but the great saving is in labor for stoking, wheeling ashes and unloading coal. Formerly, when using coal, twenty-five men were required to operate this battery of boilers for twenty-four hours; now, with liquid fuel, four men accomplish the same work. The efficiency of the boilers is increased and cost of repairs lessened, while oil flame is less severe upon the boilers.

Reference could be made, if necessary, to hundreds of persons who have had practical experience in burning oil, fully sustaining the facts given above, proving conclusively that liquid fuel is at least one-third cheaper than coal, and it is destined to be the fuel of the future.

I have thus far shown the benefits to be derived by using liquid fuel. It is, however, necessary to consider many points before deciding to adopt it, especially if your plant is in the center of a large city with other property in close proximity. Managers of insurance companies are just cranky enough to believe that oil will burn, and unreasonable enough to object to your exposing and destroying property for which they have to pay, thus burying their dividends in the same pit you are trying to avoid. Therefore they insist upon certain conditions before they consent to its use. Among other things, that you store your oil 50 or 100 feet away from your station. If this should happen to place your oil tank adjacent to your neighbors' property, you will have the officers of the insurance companies, whose policies cover his buildings, operating in a way that will drive grounds, short circuits and underground wires out of your minds for a month. If necessary precautions are taken, and the apparatus is properly and securely arranged, there is no more danger with liquid fuel than coal. In fact, it may be made safer, and insurance companies will permit its use without an extra charge for the privilege. Examine carefully, however, from an insurance standpoint, any apparatus offered you, before attempting to use it, or you may find that insurance is an expensive luxury, and operates fully as disastrously upon dividends as coal.

An iron tank will be required for storage of oil, which should be located under ground 100 feet from your station. This tank, if sixteen feet in diameter and eight feet in height, will hold 250 barrels. If twenty feet in diameter and fourteen feet in height, 600 barrels. A pipe from this must pass under ground to the car for unloading the oil by gravity, if practical; if not, by pumping. A second iron tank, holding enough oil for one day's use only, can be placed immediately outside the boiler house, with a safety pipe one and one-half inches in diameter extending ten feet into the air, to permit the escape of gas. This tank must be connected with a large tank by an underground pipe for the purpose of forcing the oil into the smaller one, with another pipe for an overflow to carry the oil back or away, in case the pump is neglected or left running.

The small tank must be lower than the burners or furnace, so that in case of accident the oil will flow back to the tank. In all pipes there must be stopcocks that will cut off communication between the burners and tanks. The supply pipe at the boilers should be arranged with a valve not over one-half inch in diameter, so that oil cannot, under any circumstances, be forced under the [illegible] faster than same is consumed by the burners, thus preventing an overflow from flooding the fire box. There must also be an escape pipe extending outside the [illegible] the tubes. In no case must the oil be allowed to [illegible] the tank to the burners by gravity, but must be [illegible] either by vacuum process, steam or compressed air. [illegible] this there are several plans. One is to [illegible] steam [illegible] the opening of a vertical pipe from the tank, and thus draw the oil up to the mouth of the furnace. Another [illegible] compressed air for atomizing the oil, and passing it to [illegible] burners. Others still use a retort and generate a gas. Unless the apparatus used is expressly arranged for start-

ing the fire, oil must not be turned on until the burners are heated, for if it is, [illegible] explosions will follow. If a station is furnished according to above conditions, the insurance companies will insure it without extra charge; if not, they will demand from 50 cents to $2 extra for every $100 insured, according to any deficiency that may exist, while if the burners are fed by gravity, it is a prohibited risk.

Faraday has stated that the chemical action of a grain of water upon four grains of zinc can evolve electricity equal in quantity to that of a powerful thunderstorm. The Springfield Electric Light company found by a practical experiment, made last December, that a small quantity of petroleum under certain conditions could evolve a sufficient amount of flame to annihilate an electric light station without any thunderstorm. They placed a storage tank, holding 100 barrels, in the basement of the main building, and another in the boiler house, containing the supply for daily use. From the last tank the oil was carried to the fires by gravity, and here was the cause of the fire. Having received a fresh supply of oil, they filled the large tank under the building, then turned the oil into the small tank in the boiler room, and left the pump working, while the men were busy in another part of the station. It overflowed the tank, and the oil escaped into the furnace, with the usual results following from gravity pressure, less oil, less building and less lights, with insurance managers running wild over the hazard of electric light buildings. Is it any wonder insurance companies object to assuming such hazards?

Holmes has said, "that science is a first-rate piece of furniture for a man's upper chamber, if he has common sense on the ground floor," but if he has not got plenty of good common sense, the more science or more liquid fuel he has the worse for him. An electric light station can be made just as safe and secure as any mercantile risk, and insured at the same rate.

It behooves the members of this association to investigate this subject, and correct the errors of the past, if they do not wish all electric light plants placed upon the prohibited list. For, why should the most powerful and magnificent system for the protection of mankind, known as insurance, and the youngest child of science, electric light, appear as antagonists upon the world's arena?

Now, gentlemen of the National Electric Light association, as there is no state in the United States, and few counties, that have not a town called "Franklin," so in the no distant future, there shall not be a city, village or hamlet, where the current which leaped to earth at his command shall not be utilized in that most wonderful invention of modern science, the electric light. An invention which is daily fulfilling Goethe's last prophetic cry, "more light! more light!"

THE CHAIRMAN: Mr. Ransom holds in his hand a paper on the subject of "The Advantages of Oil as a Fuel," which has not yet been passed upon by the executive committee, but if it is the sense of the convention it will now be read.

Mr. Ransom then read the following paper:

ADVANTAGES OF OIL AS FUEL.

BY C. N. RANSOM.

The use of oil as fuel for the purpose of producing steam is still, in a certain sense, an experiment, and yet it is no longer a question of whether it shall be used, but merely a question of the manner and method to be adopted. The general public opinion seems to be that oil must, to a great extent at least, take the place of coal as fuel. The advantages are so obvious that it is hard to find a man who does not believe that some method will be found by which a steady, smokeless, economical and easily controlled flame can be produced from oil by means of which boilers can be heated in a much more satisfactory way than is now done with coal. The great public is tired of coal, with its clinkers, smoke, dust and ashes, and the necessity of constant attention, not to say anything of the regular corners, short weight and extortionate prices.

A large part of this feeling is due to the wonderful development of oil fields and the evident fact that oil can readily be furnished at about half the present prices. The Standard Oil company, in combination with the Producers' association, is struggling to maintain the price at a high figure, but the very fact that in order to do so they are now holding back a reserve [illegible] millions of barrels, which they can at any [illegible] upon the market makes speculators [illegible] postpone the inevitable result, cheap oil, [illegible] of it. Meanwhile the California oil wells [illegible] aside from the Pennsylvania and [illegible] of large extent are discovered in Wy[illegible] in other sections of the country [illegible] the large oil fields of Canada. The [illegible] becoming less and is likely to [illegible] account of the refineries erected by [illegible] Hitherto the petro[illegible] has been to a great extent [illegible] is said to be so enormous [illegible] of one well at Baku [illegible] in Pennsylvania [illegible] Bros. [illegible] pipe line, which [illegible] in cutting off all the export trade in oil to [illegible]

due after the lower grade of refined is taken off, mainly by simple distillation. Of course, when the higher grades of refined oil, such as the "astral," are produced, the additional processes required for purifying render the oil more expensive, but as a matter of fact the residue is really worth more than the distillation. The consequence of this fact is that no Pennsylvania crude oil is used as fuel so far as we can learn. The Ohio oil, however, stands on a different basis. No process has yet been discovered by which refined oil, fit to be used in lamps, can be produced from the Ohio crude. We are informed that large prices have been offered by the Standard Oil company for the discovery of any process by which it can be done, and that this company has expended large sums of money in trying to do it, but has so far failed. The consequence of this has been an accumulation of over twelve millions of barrels of surplus stock of Ohio oil, for which the market is simply for fuel and so limited that it will not take the oil produced, to say nothing of the surplus. The fact that the residue after distillation is worth more than the distillation is especially true of this oil, and it is stated on high authority that the oil companies could easily afford to sell the distilled product at one cent a gallon and still make money from the residue. In their efforts to produce refined oil from the Ohio crude the Standard company had accumulated several million barrels of distillate, which is not refined, and which can be used as fuel if a proper apparatus is devised, but for which there is no large market to-day, and which cannot be sold for use in lamps or kerosene stoves. It is inevitable that these vast quantities of oil must be thrown upon the market, and that the price of oil must go down to a point far below the present one.

It gives one an impressive idea of the magnitude of the commerce of this country to reflect that probably nine-tenths of the vast quantities of oil sold in this country, and upon which such vast fortunes have been made, has been and still is used simply in kerosene lamps and stoves. The quantity of heat which can be developed by one pound of pure carbon is sufficient to boil fifteen pounds of water from at least 212° F., if none of the heat was lost; and one pound of coal of fine quality, under similar conditions, will evaporate fourteen pounds of water, producing 14,133 heat units. The total heat units which can be produced from one pound of petroleum are 27,531, and one pound of petroleum can be made to evaporate 285 pounds of water. These figures are taken from the work on steam boilers of Prof G. B. N. Tower, formerly chief engineer of the United States navy, and are believed to be reliable. In fact, other authorities seem to correspond.

The heat-producing value of petroleum, compared with pure carbon, is as 28 to 15; and, compared with a fine quality of coal, as 28 to 14, or 2 to 1; and 1,000 pounds of petroleum are equal to a ton of coal. As petroleum weighs 6½ pounds to the gallon, 154 gallons are equal in heat-producing power to a ton of the present coal. In practice, however, the heat-producing power of coal as used under boilers is very much less than the possible production stated. Referring again to Prof. Tower's work, we find that in actual careful tests of over forty different articles of coal the highest evaporation reached was 10.7, and the other results varied from 6 upward, showing a loss from the estimated possible result of from 30 per cent. to 60 per cent. We have been unable to learn of a single instance in which a higher evaporation than 10.7 has been reached with coal, and have learned of only a few special tests in which an evaporation of over 9 has been reached. Such results have been reached only with exceptionally good boilers with feed water heaters and the best of modern appliances to utilize all the heat, avoid radiation, etc., and with the best of coal and the most careful handling. In regular use, even in improved horizontal tubular boilers with all improvements the usual evaporation is from 7½ to 8½ pounds of water per pound of coal used, and in ordinary vertical tubular boilers the evaporation rarely exceeds 6 pounds of water to the pound of coal and is oftener less than more. All these facts must be taken into account in considering the question of the possible value of petroleum as a fuel. Coal has been the universal fuel, and steam boilers are specially adapted and built for its use. Devices for producing perfect combustion of coal and for utilizing the heat derived from it have been patented by the thousand, and constant familiarity with its use in manifold ways has produced about as good a result with coal as we can well hope to reach, and this result summed up is that whereas one pound of coal can be made in laboratory practice to evaporate 14 pounds of water—yet in common use in good horizontal boilers the average evaporation is but 8, showing a loss of 43 per cent—and in common use in upright tubular boilers the average evaporation is only 6, showing a loss of 60 per cent.

Reverting to our former figures, it is evident that if one pound of oil is equal to two pounds of coal under laboratory tests where one pound of coal evaporates 15 pounds of water and 154 gallons of oil equal one ton of coal then when there is a loss of 43 per cent. on the heat producing power of coal as in horizontal tubular boilers 88 gallons of oil (if there was no loss in using it) are equal to a ton of coal, and in tubular upright boilers where there is a loss of 60 per cent. in using coal 62 gallons of oil (if there was no loss in using it) are equal to one ton of coal.

It is evident that if such results as these could be accomplished, and other objections overcome, oil would be a universal fuel.

Whether such results can be reached or not is difficult to predict. Inventions in the line of apparatus for burning oil to produce steam are comparatively recent. Most of the inventions are in the line of atomizing or injector burners, and there are probably few if any horizontal tubular boilers in which oil is used as a fuel [illegible] atomizer or injector. Burners of that [illegible] of one pattern form or another have been [illegible] for several years. There is probably but little difference between the different varieties.

The Cincinnati Spring company wrote last June that they had probably used upward of 10,000 barrels of crude petroleum with atomizing burners and preferred it to coal, and that they had tried all kinds of injector burners, but make one out of their own that suits them better. The Michigan Bolt and Nut works of Detroit, wrote on May 14th: "We tried the 'Askins,' the 'Chicago Edwards,' and a simply constructed burner of our own, using gas pipe, and we liked ours as well as any." Studebaker Brothers manufacturers, of South Bend, Ind., wrote on May 14th: "We have not yet determined what make of burners is the best. We have had about as good results with one we made in our own shops as with any." Of this class of burners there are any variety in use with more or less success. In my brickmaking and certain classes of furnaces they seem to be regarded as being very satisfactory.

There have been, however, some serious objection to their use in boilers. In the first place, it is always necessary to make a fire in some other way first in order to produce a sufficient pressure of steam to start the burners, and it seems generally the case that they will not work on less than a 30-pound pressure. One of the consequences is that if the steam happens to run down it can only be raised again by shutting off the oil and making a fire of coal and wood. They are therefore of no use except where a long-continued high pressure and a constant fire are maintained. Another difficuly with that class of burners is that their practical use seems to be limited to horizontal tubular boilers where the flame can be allowed to shoot through a long distance without coming in contact with the iron, the flame being thrown generally upon or against fire brick.

Messrs. Keasley & Mattison the celebrated chemists of Ambler, Pa., say: "The furnace must be lined with fire brick, and satisfactory results can then only be obtained after the fire brick reaches a white heat. The fact seems to be that in the atomizing process the oil is sprayed in small globules, and if these globules strike a cool surface or one not excessively hot before they are entirely consumed, the result is imperfect combustion and a large amount of smoke. This peculiarity of injector burners seems to render their use impossible in locomotives or vertical tubular boilers. In fact I have seen letters from at least seventy different leading firms and well-known companies located in almost every part of this country stating in almost every instance that, while they knew of injector burners, etc., they never knew or heard of an apparatus for burning oil under boilers which did not require the use of steam or compressed air, nor did they know nor had they heard of any apparatus whatever for burning oil used successfully under vertical tubular boilers. I have also seen a letter from the manager of the fuel oil department of the Standard Oil company stating that he knew of only one burner which could be used under vertical tubular boilers. It is also a fact, I believe, that no burner has yet been brought into general use under house-heating furnaces. I believe it is now generally conceded that the use of atomizing or injector burners cannot be extended to embrace either vertical tubular boilers or boilers of the locomotive or portable type or even horizontal tubulars below 50 horse power. In fact the system of atomizing does not appear scientific. It seems upon its face a crude and clumsy way of producing combustion. I believe, however, that the members of this association recognize few impossibilities and certainly are quite convinced that a device can be made by which oil can be burned and which can be easily and perhaps automatically controlled; and it would seem that such an apparatus would go a long way toward solving the problem of isolated lighting. For such a device we must, I think, turn to the system of converting the oil into gas first and then burning it. It seems to me such a system is in accord with the principles of science and that in no other way can the best results be obtained from the oil. Of this class of devices the greater number have consisted of coils of pipe maintained at a high heat in which the oil is vaporized and from which the vapor or gas issues in jets and is burned. These coils of pipe, however, I think, without exception, have proved failures because of the coking or accumulation of sediment. Attempts have also been made to burn oil and water together, which have so far proved unsuccessful, chiefly because of the great difficulty in adjustment and because they have been too complicated. Another defect has been that the vapor issuing from the tubes produced a smoky flame of comparatively small heating power. Still another difficulty has existed in the fact that if by carelessness the valves were opened too far, the oil would overflow.

Some time since my attention was called to an oil burner of the vaporizing type which was submitted to several eminent scientists and to a number of practical men and was approved by them. In that burner the oil was first turned into gas and then gas issuing in small jets was mixed with air before combustion upon the general principle of the Bunsen burner. The result produced was a steady flame, entirely smokeless and in some parts the flame was a most intense blue. The flame produced was regular and of large volume. The cylinder was large and capable of producing more gas from the oil than could be discharged under light pressure through the jet holes, and the tank was elevated so as to give a gravity pressure of about four or five pounds to the square inch. The result was that the gas stood in the cylinder at an even pressure exactly equal to the gravity pressure maintaining the steadiness of the flame, and no oil would flow into the generator except as the pressure was lessened by the consumption of the gas, even when the fuel valve was opened wide.

Whether that particular device was or is the best or not it seems to me that some device constructed upon that line must produce the best results attainable, viz., the oil should be turned into gas and the gas burned after admixture with air upon the same principle as

ordinary gas is burned in stoves. Some of the advantages which a successful apparatus for burning oil would have are easily understood and are: Steady flame, perfect control—slight draft required—the power to increase or decrease the flame at will by the simple turning of a valve—the power to maintain steam at a steady pressure—the slight attention required—the power to instantly extinguish the fire without waste—the uniform heat—no reduction of fire or pressure when replenishing the fire—cleanliness—safety—economy in labor—no dust, cinders or ashes—less room required to store the fuel, and only one third the weight.

With these advantages to be derived from the use of oil as fuel, it seems only reasonable to expect that within the near future some successful apparatus will be brought into general use for manufacturing and house heating purposes.

THE CHAIRMAN: Gentlemen, there are several papers on petroleum lighting and fuel now before you for discussion.

MR. LEONARD, of Minneapolis: I do not suppose there is any member of this association more interested in this subject than I am. We are pioneer users in the northwest of oil, and I have listened with a great deal of interest to these papers, that of Mr. Francisco and that of Col. Ransom. While I do not exactly agree with some of the statements made in them, especially on the question of insurance, at the same time there are some excellent points. In the first place, the question of insurance is the only bugbear with us at present that we have to contend with. The other troubles we think we have overcome. As I stated, to comply with the requirements of the insurance companies would make the use of oil almost prohibitory. Mr. Francisco states that by the introduction of air pump, for creating a vacuum, making somewhat of a complicated apparatus, and by the storage of your tanks fifty feet away from your building, you can use it. I think it is a great mistake. I believe that oil can be introduced and used under a gravity pressure with as much safety, if not more so, than you can by pumping it. He quotes the Springfield, O., fire as being an example to a certain extent of feeding by gravity. I had the pleasure of a short conversation with the manager of that station not long since, and I was especially interested in that, as just before leaving home the insurance agent informed me that a policy of one of his companies was canceled. I asked him why: "Well, they will not insure because you feed by gravity." I said, "All right, I don't care." In my conversation with the manager of that company, I asked him what his arrangement was. He stated that his storage tank was underground, and also under the building in the building practically; that his supply tank was above ground, holding, I think, twenty four barrels or thereabouts; that tank was also in the building. An oil pump was used to pump the oil from his tank cars into his storage tank, and also into his supply tank. The supply tank was an upright tank, and on the top of it was a manhole which was left open at times. The pumping of this oil stirred it up more or less and created a great deal of gas. The gas escaped from this manhole, and the building was more or less filled with it. The oil, as Mr Francisco said, overflowed and came out through this manhole. Gravity had nothing special to do with it, that is as to being used for feeding his boilers. It overflowed and ran down the tank and ran over the floor to a lighted lantern that was left by one of the employes of the company; naturally it caught fire, and the result was that we had a bad fire, and abandoned the use of oil as being impracticable for steam making purposes; not entirely for that alone, though, as he informed me that he also received considerable damage to his boilers. The only thing that surprised me was that he had not burned up long ago. He had a regular firetrap there, and it was only a question of time when the accident that happened to him was bound to come. Now, I claim that the use of that oil should not be condemned generally by insurance companies because one man has it put in by a very poor arrangement. We have studied that very carefully, and I believe, and I know, if the opinion of insurance men can be counted as good for anything, that our entire building could be burned to the ground and not the least particle of damage be done to our oil apparatus and our oil storage tank. We have a capacity of about 26,000 gallons in two tanks; they are eight feet in diameter and thirty feet long, placed underground, as I stated, about twenty-five feet from our building, walled up on the side, imbedded in solid masonry and arched over at the top with brick. We have a space between the two tanks about six feet, giving plenty of room for a man to go down there. We have valves at the opening of the tanks where the oil is admitted to the supply pipe and can be cut off there, at the entrance to the building there is another valve where it can be cut off; as it flows along the supply pipes there is another valve before it gets into the building, making four valves before the oil reaches the burner; so that I still claim that the condemnation by insurance companies of the use of oil on general principles, because this man or that man has a poor arrangement and has burned up a station by the use of it, is all wrong.

MR. LOCKWOOD: I have listened to the papers upon this subject and to the discussion with a great deal of interest. The company which I represent in Detroit have been using crude oil since the first of July last, and we have used it continuously. I think when Mr Francisco states in his papers that the gravity system was by far the most dangerous and would not be allowed, he evidently believed what he said; but I think he made a great mistake. I think the question to be determined is which is the safest; that is, the question of which would allow the most oil to escape through a break or a leak in a pipe in a given time. In running by the gravity system our small tank, which brings the oil to the burners under the boilers direct by gravity, has the capacity of about one barrel per hour and we have [illegible] so we have always on hand oil enough to [illegible] [illegible] part of the day which would run about [illegible] per hour. In the light part of the day that [illegible] of oil would last three or four hours. Now [illegible] in the heavy part of the day is enough [illegible] pumps if you have an extra pump on hand [illegible] ning as we are we have never had the slightest [illegible] and I know where a leak occurred in one of [illegible] there would be a far less amount of oil [illegible] through that leak in a given time than it [illegible] pressure as the pressure system used, I [illegible] be ten pounds to the square inch at least.

Now the manager of one of the largest [illegible] companies came to our plant and examined it thoroughly. That subject came up. He was under the impression that the pressure system was the only safe one, but he finally changed his mind and said that he would recommend in the future that the gravity system be employed, and with a small tank which furnished the oil be [illegible] to one barrel per boiler per hour and that would [illegible] capacity enough.

Our plant is different in one respect from any that has been spoken of, inasmuch that the large tank, although under the ground, is within one foot of our building; and we are right in the heart of the city of Detroit. And still as close as we are to other buildings with the capacity that we have there, the company only charges us 20 cents additional rate of insurance, and still we use the gravity system. We have been using that since July last, and have had no trouble, and even with that small capacity to feed the boilers, we can always get our extra pump to use in case one pump gives out, so that we will not be out of oil. Mr. Francisco spoke of a case where the tank had overflowed by gravity and caused a fire. If that had been arranged as we have ours arranged in Detroit, that would have been an impossibility. We feed from the large tank under the ground to the upper one by means of a pump, and the pipe is only a one-inch pipe. We have from the upper tank returning to the lower a three-inch overflow pipe, and the three-inch overflow pipe will carry more oil than the maximum capacity of the pumps. Second, if the oil is allowed to raise too high, it can do nothing more than simply to return to the tank from which it is pumped.

We also have connected with it one other safeguard which I think is a necessity; that is, the pipe feeding the oil from the small tank to the burner is connected at the level of our floor with the overflow pipe returning to the large tank with a cock opening valve, so in the event of fire if this valve is opened in less than two minutes every bit of oil in the building within the small pipes will be thrown back to the large tanks.

And the insurance inspectors have approved that system, and only charge us 20 cents additional to the old rate. Our oil costs us 60 cents per barrel delivered in our tanks. The coal we used before was soft slack, and it cost, during the different periods of the year, from $1.90 to $2 to per ton. I have found upon close investigation and close analysis to be about the same expense for oil as the coal was, but I find it to be a saving in the way of convenience, as we have had two or three cases in the last six months where it was of the greatest necessity to the employes to suddenly stop; with the oil we have been able to shut off in an instant and to resume again without any loss of time.

Now, I would like to ask one question. Each of the gentlemen have spoken of the evaporative quality of oil as compared with coal, but they have left out one question. In coal the total amount of water evaporated is used for effective work; in oil part of it is used in the pressure. I would like to ask if any of these gentlemen have any definite information as to how much this water evaporated by the oil is used in the pressure.

MR. FRANCISCO: I have been inspector general, inspector and general agent and adjuster of insurance companies for twenty-five years. That was my business until I took up the electric light business, in fact, I am in it now. I think I can safely speak in regard to the insurance of goods. I have consulted nearly every one of the prominent companies of the country in regard to this very question and in regard to these various points that I have developed in my paper. The insurance companies' managers have told me that if the electric light folks would adopt the plan I have proposed they would insure them, but if they did not, they should charge them as I have specified. Now, I am president myself of the Underwriters' association of our state, Vermont, and therefore I think I know what I am speaking about when I talk about insurance.

In regard to the Springfield matter I wrote to the manager of the Springfield paper about insurance. I wanted to know what the cause of that fire was, and especially as I purposed to use this crude oil in my own station. He did not answer my letter. I then wrote to a prominent man in Springfield, and anybody who knows the man will guarantee his authority as good. He went there and made a personal examination of the situation, and got all the facts in regard to the fire, and it was just as I stated in this communication of mine, he puts it on paper and signs his name to it and sends it to me, so my authority is clear and I can rely on his statement.

Now Mr. Leonard's theory about these valves and all that is all right. There is no objection to them. But the point comes just here, there are always a lot of fools around electric light stations the same as everywhere else so far as fire is concerned, and your station may have forty valves, but what good would it do to men situated in the other part of the building? What good would his valves do if he had fifty of them as long as there was no one to take charge of them?

In the case in Winsted, Conn., where they used petroleum oil, the station burned up awhile ago. The insurance was paid. Insurance companies get their information by sad experience and they know what every one of these things come to. When they draw their checks in five, ten and thirty days, as they have time and time again, they [illegible]

[illegible] Although I am in the insurance business it is very difficult for me to get insurance [illegible] I can't write insurance on my own station, and I have not been able to get enough insurance notwithstanding the fact I was right in the business. Now there are millions of dollars invested in electric light plants. It is all right as long as you get something back. If a fire comes, or your station is wiped out, then where is your stockholders' money? If you have no insurance, where are you? If you have, of course you are all right. Now, the question is if the insurance companies go back on the electric companies, and won't write insurance on their plants, what inducement or what argument are you going to produce to get capitalists to put money into electric light stations? I think these objections can be obviated in the manner I have proposed.

Just before I left home, I offered the risk to the agent of one of the biggest companies in the country, on my own station, which he declined, saying he would not write it at any price. "Well," he said, "to be candid with you, we don't know anything about it; therefore, we take the safe side and refuse." I took him through the station and explained the whole modus operandi to him, and after he got through then I showed him this paper. He said: "I want you to send a copy of that paper to our company, and we will investigate this matter, and if you will send it to the Insurance exchange, and we will investigate it; and if the electric light folks wish to meet us, we will meet them at any time, and have a committee appointed to investigate this whole matter." Now, there is the basis of what you want to do. My suggestion is that this association appoint a committee to meet a committee of the insurance companies to investigate this matter and put it upon the proper basis, and enlighten them upon this subject of electric plants.

I claim that they are just as safe as mercantile risks. I have examined that subject, as I said, from the insurance company's standpoint, and I ought to know something about the insurance part of it even if I do not know anything about the electric part.

MR. LOCKWOOD: I stated a few moments since that our insurance in Detroit, under the conditions that our plant has been erected, was only increased 20 cents per $1,000, and what I now add is this: that when we put in our crude oil plant our insurance was very nearly expired. It did expire about three months since, and I have since renewed it, and renewed it at the same rate, and the result is that in the insurance, with the exception of paying at the rate of 20 cents more for $1,000, I have no trouble now in placing our insurance as well and easily as I did before. In regard to the danger of using the gravity system, I think, as Mr. Francisco says, that it is simply a question of putting it where it is less liable to do damage by means of ignorant handling; and that resolves itself down into one question. In the event of a break occurring in the pipe, the valve being constantly open, or open by mistake, that allows the oil to escape.

THE CHAIRMAN: A motion has been handed up providing for the reconsideration of the motion to continue the committee on the New England Electric exchange, passed this afternoon.

The motion was reconsidered.

E. L. Morrison offered a resolution, that a committee of five be appointed, with P. H. Alexander chairman, to recommend a tax by some means that would secure to the National Electric Light association the advantage now enjoyed by the New England Electric exchange regarding the pleasant business relations between the electric interests and the insurance interest and report at the next meeting of the association.

The motion was carried.

THE CHAIRMAN: If the members will remain in session we will continue the meeting. We have a paper by Mr. A. C. Chenoweth who is not present, on "Conduits, their material in relation to underground conductors." As the gentleman is not present the chair will take the liberty of ordering it printed in the proceedings.

Mr. Chenoweth's paper was as follows:

CONDUITS, THEIR MATERIAL IN RELATION TO UNDERGROUND CONDUCTORS.

BY ALEXANDER C. CHENOWETH.

I have the pleasure of presenting to this convention some observations in relation to [illegible] lated [illegible] Many [illegible] of various kinds [illegible] in New York, Brooklyn, Philadelphia, and other cities. [illegible] perfect [illegible] decay, the conductors have [illegible] of [illegible] in various stages and many have [illegible] entirely those covered with rubber compounds [illegible]

[illegible] protected by a lead covering. Very little attention has been given to the subject of electro chemistry, failure being attributed to various causes; remedies [illegible] of a practical nature, suggested by mere circumstance, in order to counteract the supposed evil. That electro-dynamic forces have contributed to the trouble can hardly be denied. Creosoted wooden ducts and [illegible] forms of construction. Illuminating gas and moisture were found in most all of them. Rubber insulation was rapidly destroyed, and lead-covered cables were corroded to such an extent in creosoted wooden ducts that other cables covered with an alloy of tin and lead were substituted, and even with these it was found necessary to coat with paint, hoping it would prevent any action from taking place. In the iron tubes corrosion was much slower.

After a careful examination of conduits and conductors, I am led to believe that this decomposition of insulation and covering is due to an electro-chemical decomposition. The existence of thermo-electricity, or a natural voltaic arrangement in the earth, is without doubt true. But the establishment of the principle that a certain electrolytic intensity is necessary before decomposition can be effected is of great importance to all those considerations which arise regarding the probable effect of the earth currents. For to produce an effect of decomposition or of combination a current must not only exist, but have a certain intensity before it can overcome the quiescent affinities opposed to it, otherwise it will be conducted, producing no permanent chemical effect.

In electro-chemical decomposition the effect is produced by a force either superadded to, or giving direction to, the ordinary chemical affinity of the bodies present. In this view the effect is considered essentially dependent upon mutual chemical affinity of the particles of opposite kinds. Bodies dependent on weak affinities very rarely give way. Take for instance glasses, those formed by silica and an alkali. It is evident that in all cases in which decomposition does not occur it may depend upon the want of conduction; this being true, good conductors should never be selected for conduits, such as iron. Metals, owing their high conducting powers, make admirable poles, and yield to electro-chemical decomposition. It is true that some of the metals would not be decomposed, as they are costly and not available for use. The subject I present must be settled by weight of evidence rather than by simple philosophical conclusions.

I call your attention to a piece of cable that was removed from a creosoted wooden conduit in Brooklyn. The lead covering was eaten full of holes. It had been down over a year. Creosote was attributed as the cause of decomposition. Illuminating gas and moisture were present in the ducts. It was reported a rubber compound insulation was destroyed in the same duct. Examination was made of iron conduits with lead-covered cables in them, and decomposition was plainly seen in various stages, although the lead covering was not so rapidly decomposed as it was in a creosoted wooden duct. Moisture and illuminating gas were present. The deposit on surface of lead-covered conductors proved to be carbonate of lead.

In pursuing this examination I found a peculiar case that deserves some consideration. I found exposed to view in a manhole a cable that was covered with an alloy of tin and lead. This cable had been down about four months; it passed through the manhole on into the duct; the part exposed to view was about seven feet; the duct was constructed of iron and cement. On one side considerable decomposition appeared, being very active for about two feet of the exposed part, which rested on the bottom of the manhole. A large iron pipe for water traversed the manhole parallel to the cable. The crystals of decomposed lead extended over toward the iron pipe, being quite profuse, adhering to the brick and side of manhole. An examination of the white crystals proved to be carbonate of lead. Moisture was present, but no illuminating gas. I placed a piece of lead on the cable at this point. After two months I removed it and found the same covered with crystals of carbonate of lead, showing signs of electrolytic action between the lead-covered cables and iron pipe that traversed the manhole, moisture acting as the exciting liquid.

I found in Brooklyn a cable that was conducted into a building some distance from a creosoted wooden duct; this cable was also decomposing in spots, while no odor of creosote or illuminating gas could be detected. The moisture [illegible] accelerated by creosote and illuminating gas. This action may be explained by the [illegible] caused by the reaction of the constituents of each [illegible] as they are by the supervention of the electrical currents; portions of the prox[illegible] in the direction of the [illegible] of a secondary kind capable [illegible] their transfer, and being equally affected by [illegible] matter they are [illegible] of metal or air [illegible] in the [illegible] ground [illegible] duct in [illegible]

electrolyte, and establish an action with the metallic tubes for the purpose of holding it.

A triple silicate of lime, magnesia and alumina, artificial stone, constituents of which combined form a substance more neutral than any other. The selection of this material for underground structures in form of concrete was probably the result of long experience rather than the knowledge of its material relations, as presented by electro-chemistry.

Attempts to counteract the electro-chemical action on a lead-covered cable by placing another substance in juxtaposition has not proved a preventive; it may delay it; also the alloying of tin with lead. Metals may combine when melted together, but they do not remain combined after the solidification of the mass. I present here an example of this case. I refer to a piece of brass tube that was used for pneumatic transmission by the Western Union company in New York, it being buried in a wooden box in one of the streets of New York. After it had been down some time it was so eaten full of holes that it required renewing. Upon examination you will find the zinc is eaten out, while the copper remains perfect; the action was on the outside, while inside the brass remained perfect; air traversed the inside continually, while moisture and other causes produced an electro-chemical action that I do not think can be imitated by any known arrangement of conditions so as to leave the copper as shown in this example, thus showing the peculiar effect of the earth currents in decomposing the zinc in this alloy, then removing it entirely. Moisture and gases must be removed by ventilation. In order to accomplish this the diameter of the conduits should be not less than four inches, and some relative proportion be established between the diameter of the cable and diameter of the duct, otherwise the power required to force air through would be beyond an economic limit.

The subject of ventilation for electrical conduits not only becomes necessary in order to protect the conductor in them, but in order to protect life and property. Thursday, Dec. 20, 1888, an Edison manhole exploded in Maiden Lane, New York city. January 19th, one month later, an explosion took place in Nassau street. November, an Edison manhole exploded in Boston. These explosions have been attributed to accumulation of gas.

F. H. Whipple read the following paper

"Municipal Lighting."

BY FRED H. WHIPPLE.

There are so many difficulties encountered in a proper consideration of the title of this paper that one does not embrace the suggestion to discourse upon it with enthusiasm. It is a subject seemingly rebellious to analysis, yet one that requires to be treated in language whose clearness is inexorable. In these times one writes and speaks to the multitude, and upon questions broad in their scope and far reaching in their effects one ought never to shut himself up in any sort of freemasonry of his own building. When an issue such as this presents itself to the electric light world for discussion, it should be treated fairly and squarely, with intelligence and judgment, and without the heated arguments of business controversies.

"Municipal Lighting," as generally considered, means the municipal ownership of the plant. I think this definition is erroneous, for the reason that the greater portion of the income of two-thirds of the electric light companies of the country is derived from their public street lighting contracts. Of the total number of arc lights manufactured by private companies who are parties to a city contract, 68 per cent. are public lights, and are paid for by the municipalities. On the other hand, of the total number of arc lights upon the streets of the land, but one-third of one per cent. are owned and operated by municipalities. Therefore the logic of the subject is not confined entirely to the question of ownership. The issue, to my mind, is based as much upon the rental value of an arc lamp.

What is the rental value of an arc lamp? Statistics regarding the price paid by various cities are not lacking, but comparisons are worse than useless, for they seemingly go upon the principle that a light is a light, no matter what it lights, what it costs to produce it, whether it has good illuminating capacity, or whether the system be an inferior or superior one. The prices for light vary materially in different places, but I have been unable to see that they vary in accordance with any fixed relation to any other factors which would seem to have a bearing on the service. It may be truly said that nothing has an absolute value. It would be impossible to prove, on a general hypothesis, that 50 cents, or any other sum, is in any place the exact value of an arc light, but in this, as in all other cases, some price must be fixed

In the staple articles of the world's production the law of supply and demand regulates prices; but as electric light companies, in their relations to city councils, act under influences individual in themselves, the case is very different. The price of light for commercial purposes is to some extent regulated by the fact that moderate prices materially increase the consumption, but in municipal lighting, the city, if it accepts the terms offered, generally pays the contracted price. It is, therefore, in many if not in most cases, a matter of comparative shrewdness of the officials on either side as to the price paid, and the service rendered.

There are to day in the United States 316 cities and towns whose streets are wholly or in part illuminated by electric lights furnished under a public contract. The highest price paid for an arc light of nominal 2,000 candle power, burning all night, is $[illegible]. The lowest is $40. Between these two extremes there are [illegible] prices. Upon the moonlight schedule the maximum figure is $165, the minimum $[illegible].

What makes these wide differences in price? Granted that in some places local conditions, excessive competition or the absence of all competition have weight in determining the cost of production, what reason shall we give for the varying figures tabulated in a wide field of localities where the conditions are almost absolutely identical?

The average [illegible] of [illegible] public lighting in the United States to-day is $[illegible] per light, for schedule lighting $[illegible]. In 1885 the cost was, on an average, $167 per light for all-night lighting and $135 for schedule lighting. In 1886 it was $160 and $125. In 1887 it was $130 and $117. In 1888 it was $129 and $114. Thus we find that the price of public lighting has been steadily decreasing for several years, and to a very large extent within the past few months. Contracts that have been renewed since the last meeting of this association in September show a net reduction upon all-night lighting of 23 per cent., and upon schedule lighting of 19 per cent. The general run has been from 15 to 33 per cent., but there are several cases reported where the reduction has exceeded 50 per cent. An increased contract price is rare, less than a dozen in the country so reporting, and the highest figure reached is 20 per cent., while the lowest is 8 per cent.

These statistics do not furnish any guide as to the rental value of an arc lamp. The price paid by one city is often twice as much as that paid in a neighboring city, yet one would scarcely wish to be quoted as saying that the cost of production was in the same relative proportion. It is obviously worth more to produce a light in one place than in another, but is it worth twice as much? It will no doubt be said that different degrees of illuminating candle power enter into the problem, but in my computations I have considered none but nominal 2,000 candle power lights. Sometimes the area lighted is pushed forward in explanation, but this has no connection that I can see with the cost of the light itself.

There is really no fixed basis upon which to charge for public lighting, nor any general data by which a fair rate may be arrived at. I am, therefore, of the opinion that coincident with the discussion of ownership should come that relating to the value of the light, for this is really the primal cause for so much agitation of municipal control.

When it comes to the question of ownership there are three parties in interest: the parent companies who manufacture the material to be used, the local companies that have invested their capital in a business they have the natural right to make as lucrative as possible, and the public, represented in an intermediate capacity by municipal councils. Accordingly, we find three separate and distinct views taken of the question, and we are forced to believe that all three are right from their standpoint.

Of the three factors the local companies are the only ones presenting a solid front. They are united in the expression that municipalities ought not to do their own lighting. In view of the constant decrease in the price of electric lighting previously shown, and the transitory periods of electrical machinery, the local companies are mechanically correct in their claim to be able to generate electricity as cheaply as a municipality. Many of the circumstances by reason of which the sentiment favorable to municipal ownership became prominent do not have force to-day. The new and improved formulæ and the cheapening processes of production private companies are able to take advantage of where municipalities would not. Compound and condensing engines have made it possible to reduce the cost of power; more light is produced from a less expenditure of energy; carbons have fallen from $50 and $60 to $8 and $10; it is no longer necessary to locate a station in the central, and therefore the most expensive portion of a city, and more attention is given to water power. All those are contributory to the claim of the private companies that municipalities should not enter into an investment the extent of which they are ignorant of in the face of a declining market.

With the parent companies the effects of municipal ownership are just beginning to be appreciated. There is no doubt but these organizations will at no distant day be brought squarely to face the alternative of refusing to sell material to municipalities altogether, or of going out of business. It has been their custom, while acknowledging an unwritten obligation to protect their local companies, to consider that they are not bound by any special dispensation to refuse a sale when the opportunity presented itself. They are not prepared to say that it is inadvisable for a city to operate its own plant so long as the city already has the other fellow's system installed. When it comes to a city which has a private plant of this or that particular system, then this or that particular parent company is decidedly opposed to the city embarking in the business.

For these truly natural characteristics capital is quickly bringing the parent companies to a halt. No company is large enough or financially strong enough to organize and operate the local companies necessary for the times. Therefore it is local capital and local activity that is the mainstay of the parent companies. Capital is always nervous, and we can readily see that with the continued growth of a sentiment favorable to cities doing their own lighting, capital will not run any risks. It will not invest in a city or town where a community interest stares it in the face.

There is another reason why the municipal ownership of plants does not run parallel with the interest of manufacturing companies. In the case of the municipality the net result of a year's operation is public property, while it is to the interest of private corporations to keep within their own knowledge the actual outlays. A larger increase in the amount of goods required may also be expected from them than from municipalities. And from the exasperating incidents of carrying through a municipal deal, with its attendant train of demoralizing influences, every company would fain be freed. I do not believe there is a parent company in the country that has made money by selling plants to municipalities. I know some who have lost money, and I wonder that as a whole they are not ready to commit themselves unqualifiedly and negatively upon the subject of municipal ownership. The time is near when they will be forced to go upon record in this matter, but to-day they are vacillating and uncertain. They believe that in some cases it would be a manifest advantage for cities to own their plant, and in other cases just as manifest a disadvantage. They would like to have each case stand independently.

In considering this subject from the standpoint of the public servant, it becomes at once a question of advisability, to which is naturally attached, although seldom considered, the element of responsibility. The theory of the

political economist is that the monopolies of service should be owned by the municipality, and all belong to the community. In European countries this idea is carried to a much further extent than in our own. In many English speaking communities the public service does not stop with light, water and transit, but municipal ownership often extends to the bath, the laundry and the bakery.

It has been more gradual in America, doubtless because the tendency of the times in all municipal governments is toward political aggrandizement, and that it inevitably leads to corruption and a debauchery of the public service. It has therefore become necessary to largely restrict the functions of the local governments by more general legislative bodies. In America politics is the national characteristic, and the ordinary politician is only theoretically honest. He recognizes moral turpitude only to the extent of dreading exposure of his own backslidings, and while if he break the law, he nevertheless outwardly insists on the sanctity of the law. Municipal service can be, and ought to be, administered with quite as much freedom from assumption as when in the hands of private parties. But in few instances do we find it so administered. We are thus confronted with a condition, not a theory, and in the municipal ownership of electric-light plants this condition is easy of demonstration. I believe I can truthfully say that the experience of city governments in this line has not been in all respects satisfactory. Starting out a year ago as the investigator for a large municipality, I have closely studied the workings of almost every city plant, and with but one or two exceptions I would not now commend their operation. The officials of the smaller towns where municipal plants have been installed, with an amount of crude ignorance of the subject that is truly appalling, do not hesitate to assert that they and the people are well satisfied with the experiment, but in the majority of cases these officials are in office largely through the machinations of rings, and it would not be in the line of policy for them to decry the schemes of their associates.

The illumination of towns by themselves is on the intermittent plan of lighting, the hours varying so that no basis for comparison can be arrived at. The average advocate misinforms the investigator by holding up to view the proposition that these cities are doing their lighting for a merely nominal cost, while his figures are really superficial and not entitled to support. They are figured on isolated conditions to suit the emergency, often with items charged to other departments for the sake of a plausible showing in the lighting account. On one occasion, where I was called upon to estimate the cost of all-night service for a large city, upon its merits, my figures were $92 per year, with interest and depreciation, and that I think is not very far from the cost of an arc lamp in our average communities. A strong claim is made that, with the prejudicial influence of politics that enters into their management, municipal stations have reduced the cost of public lighting in their localities over the contract system.

I have previously stated that the average present price of public lighting in the United States is $121 per arc lamp per year, burning all night, and $110 per lamp burning on schedule. The average cost to municipalities which are furnishing their own light is $76 for an all-night light, and $44 for what they term a schedule light. This schedule is deceptive, and does not provide for as many hours' lighting as the usual contract does. Therefore the latter suffers by comparison. It is often the case, also, that the light is furnished in connection with some other department which bears a portion of the interest and depreciation account. Free water power and sometimes so called free attendance also enter into these figures and distort them.

The only argument worthy of consideration in favor of municipalities doing their own lighting is that of cheapness, and emphasizes what I have said, in a previous part of this paper, that an important question involved is the rental value of an arc lamp. Municipalities have not yet succeeded in reducing the price of light abnormally below the average. I do not consider the fact of any weight that a city, by reason of its not being compelled to pay taxes, and because it has no profit to make, can manufacture light cheaper than a private company, for I expect that what it saves in this way will be counterbalanced by losses caused by the influences of its management.

Here arises the question of a personal financial responsibility. We have become accustomed to consider that all public business, being in a sense everybody's, is really nobody's, and too often it is the case that a mere perfunctory public duty is performed for the sole sake of the salary attached to the office. Any business enterprise to be conducted successfully ought to be carried on by men who are financially interested in it, and who feel in their own pockets the cost of every expenditure. A city government cannot possibly take that view of it, even though its departments were paved with good intentions.

There is but one view, and that a conditional one, in which municipal ownership can be indorsed. If the expenses of the plant can be kept within reasonable bounds; if the management is in all respects such as you would commit your own private business to; if there are no outside prejudicial influences, then from the standpoint of the their own lighting. Without these qualifications it would be inadvisable.

The price of public lighting has outstripped all other questions in the financial management of our cities. It has become, if not the chief source of expense, the greatest bone of contention, and the electric light companies that will observe the handwriting on the wall and meet the subject half way will do much to dissipate this sentiment antagonistic to its interests.

There is room for improvement in public lighting. Contracts are not made by people living in a millenium, but by the mingled good and bad as they are found in the business world and municipal councils, and as they probably will be found for some time to come. There are several sides to this as to all questions, and there is a happy medium. In this medium the electric light fraternity should clasp hands with the well-meaning and observant public servant and see to it that while fair profits are returned for the service rendered a union of interests is formed, cordial in its nature, though commercial in its results, and there will then be no occasion for public sentiment manifesting itself in the municipal ownership of electric light plants.

THE CHAIRMAN: Bearing upon this same subject we have a paper on "Municipal Ownership of Commercial Monopolies," by A. R. Foote of Cincinnati.

A. R. Foote of Cincinnati read the following paper:

MUNICIPAL OWNERSHIP OF COMMERCIAL MONOPOLIES.

BY A. R. FOOTE.

Since the day when Hermes Mercurius Trismegistus went up into the Mount of Regeneration, with his son Tat——, to recite his secret sermon, it has been clear to all thinking minds that, by the use of terms, the people are deceived.

This subject should not be called "Municipal Ownership of Natural Monopolies." Its true name, designating accurately the economic principle which it advocates, is Municipal Slavery—a scheme to enslave capital and pauperize the people.

The economic principle advocated is not in accord with natural economic law; therefore, it is an obstruction to the progress of civilization.

You who are here assembled know that all progress is due, and must ever be due, to the discoveries of science being made available for the uses of man. There is but one science—the science of natural law. The nearer its devotees or investigators arrive to an understanding of natural law, the nearer they apprehend the truth. Actions guided by truth are the guarantors of benefactions.

You who have experimented, with great patience and at great cost, to discover the natural laws governing the generation and control of electric energy, know how impotent all your devices are to compel that energy to serve you, if they fail to comply with the conditions of those laws. The same fact is true in economic science. If economic policies do not correctly apprehend and comply with natural economic laws, then the effort made is impotent to secure the best economic results.

Public ownership of commercial monopolies is advocated upon the supposition that, if worked without a profit, the economic result will be a benefit to the people. Work without profit is slavery. That slavery is not an economic benefit is proven by the experience of all men in all ages.

A man is foolish who expends time and money in an attempt to invent a thing that he can find ready made. A community is foolish to undertake an economic policy that all the data of the human race prove to be wrong; a policy which, in the very nature of things, must be absolutely wrong.

That capital is entitled to a profit for its use and risk is the foundation law of all economic science. There is not a recorded instance in the history of finance where an interference with the operation of this law has secured a permanent benefit for the people. All evidence shows that, where this law is allowed to operate with the greatest certainty, there capital is most abundant, works on the smallest margin, and produces the most healthful progress.

Capital is the conserved energy of individual action; it never loses its individual character.

When the attempt was made to christianize communities by government authority, they remained barbarians. When communities attempt to become rich by operating commercial monopolies without a profit, they will be made paupers. Religion is individual rightness. Capital is individual energy, conserved for individual betterment. Civilization makes progress through individuals becoming better and richer.

A man's capital is his power to produce. Surplus is the product of energy in excess of the wants of life. Capital is the conserved energy of surplus. Surplus is an individual creation, and belongs by natural right to its creator. To abrogate the law of increase for use and risk is to destroy the only economic inducement men have to create a surplus. Deny men the ownership of their surplus, and they are forever slaves. Deny men an increase for the use and risk of their surplus, and all the forces of progress will be forever paralyzed.

The application of these generalizations to the question before us is easy.

First. There is no municipal surplus, unless it is taken from the surplus of individuals by taxation. This makes the individual poorer.

Second. Working public monopolies for a profit is securing income by indirect taxation. Indirect taxation is a tax on consumption.

Third. When public monopolies are not worked for a profit, their products are sold at a reduced price. This compels all private capital to abandon the business undertaken by public monopoly. By this process all the forces of progress for that industry are paralyzed.

Fourth. Every industry grows as long as it produces, or gives promise of producing, a profit for the use and risk of the surplus invested in it. When, for any reason, the hope of profit fails, the industry dies. Expectation of profit is the life of industry. Its growth is in ratio to the per cent. of profit promised, plus the certainty of securing it. In the beginning, surplus created in some older industry is transferred to a new undertaking to give it life. If the new undertaking fails to create a profit, it loses its power to draw life from other industries and dies. It has failed to demonstrate its right to exist. For this reason, that man who so orders the conditions under which an industry must be worked as to deprive it of the power to create a profit is its murderer.

I know of no industry which has been developed to the best of which it is capable under public ownership.

This subject may be illustrated by reviewing the development of the gas lighting industry. Sixty eight years ago, the first plant in the United States was installed in the city of Baltimore. To-day there are about 1,000 plants in operation, which have cost about $500,000,000. If this in- [illegible]

the power to create a profit, could this enor[illegible]

[illegible]

are in line with the improvements of to-day. Richmond is now engaged in improving its plant. When the [illegible] finished, as ordered, it will be in line with the improvements of ten years ago. One special point avoided in making changes is the reduction of the number of employes. Is there any political significance in this? Philadelphia has just contracted with private capital to furnish 3,000,000 feet of gas per day to the city gas works. Why? Because the city cannot make it for itself, as its works are not supplied with the necessary improvements.

A comparison of the price of gas in six cities:

	1873.	1888.	Per cent. of decrease.
New York	2.75	1.25	54½
Philadelphia	2.30	1.50	35
Baltimore	2.75	1.00	63½
Richmond	3.00	1.50	50
Cincinnati	2.25	1.15	49
Cleveland	2.50	1.00	[illegible]

By why give data and make comparisons that have no scientific value, because all the factors influencing the result are not considered? If public ownership is not founded on correct economic principles, then the result of such ownership cannot produce the best economic results.

Let us now consider the effect of public ownership on our own industry. It is acknowledged that no city has yet undertaken to supply its citizens with a complete electric service. If the industry is to be developed by public ownership, why do not these cities commence in line with the progress that has been made? If they have not the enterprise so to commence, can there be a reasonable hope that they will ever catch up, keep up, or contribute to the forward momentum? To-day, private capital is ready to install electric central stations having proper apparatus and sufficient capacity to perform the entire electric service of a city.

This service now includes:

Arc and incandescent lamps for street lighting.

Arc and incandescent lamps for commercial lighting.

Incandescent lamps by meter measurement for domestic lighting.

Stationary motor service for all mechanical uses.

Motor power for operating street cars.

One of the largest companies manufacturing electrical apparatus has installed electric central stations in about 160 cities. The combined capacity of these stations would fall far short of performing the entire electric service for the city of Chicago, if the service in that city was developed to the best of which it is capable. Can anyone calculate the difference in cost of installation, operation and administration between one station, combining the capacity of the whole, and that of the 160 stations located in as many different cities? To-day, electricity is at its highest cost, and gas at its lowest cost. Gas has fifty years the start.

To supply a complete electric service to the cities of this country, in a manner now known to be practical and best, will require the investment of over $1,000,000,000. Do the manufacturers of electric apparatus expect this vast sum to be raised by successive tax levies? If not, then they must secure its accumulation through private ownership, operating all electric central stations for a profit. There can be no hope that the electric industry can reach the highest degree of prosperity of which it is capable, if it is sold into slavery in its youth.

Fortunately for us, our industry is not the only one needing defense against the promulgation of communistic theories.

Those who advocate such theories are consistent enough to push them far toward their logical conclusion. It is well that they do so, for it is the most helpful service they can render those who would resist the encroachments of their economic policy. In elaborating their theory, they furnish all the proof needed to show its fallacies.

Professor Richard T. Ely, Ph. D., associate professor of political economy in the Johns Hopkins University, Md., may be recognized as chief in the school of communistic philosophy. By reading his books it is easy to see how, as he familiarized himself with the idea of public ownership, the list of so called "Natural Monopolies" expanded, until by it he furnishes a logical reason why all industries should be so owned and operated, if any one of them should.

A mere mention of the monopolies he recommends cities to buy will give a good idea of the progress he has made in communism.

They are as follows: Gas supply, street car service, highways and streets, electric lighting, all railways, canals, bridges, lighthouses, ferries, docks, harbors, natural navigations, postal service, telegraphs, telephones, abattoirs or slaughter houses, markets, union depots, express business.

This list illogically associates non-commercial with commercial undertakings. In it are embraced a large percentage of the industries of the country. If it is so desirable for the public to own so many, why specify? Why not own all industries?

It would be interesting to know what additions would [illegible]

be made to public investment, public income, public [illegible], and to the number of public employes, if the recommendations of this economist were acted upon, and this entire list of undertakings were at once transferred to [illegible]

Could the party then in power ever be voted out?

[illegible] another way. It shows the interests that should unite with us in combatting communism.

In his address before the Boston Merchants' association, at its annual banquet, Jan. 8, 1889, Professor Ely said:

"I say, then, that cities should pursue a policy looking to the ultimate ownership and management of all local monopolies [illegible]. This is most intimately connected with local taxation. One of two methods may be pursued.

"*First.* These monopolies may be worked for a profit, and by profit taxes may be reduced; or,

"*Second.* Charges may be reduced, and increased general prosperity will furnish a more plentiful source of taxes, and thus allow a reduction of the rate."

Profit on the products of public monopolies is taxation on consumption. Taxation on consumption is indirect taxation.

Since Professor Ely recommends that gas lighting, electric lighting, street car service, and numerous other industries be owned by the public, and then operated for a profit to reduce taxation, it will be well to learn his views on indirect taxation. Here they are:

"Indirect taxes violate the principles of equity, . . . we import salt and tax it 50 per cent. of its value. Does the rich man consume more salt than the poor man? . . . We have in a tax like this what is called a regressive tax a tax which increases as income decreases—*the worst kind of tax, and the most unjust.* . . . Indirect taxation does not discriminate between the last dollar of the poor widow and the dollar which is only one in an income of a million. It raises prices, reduces the value of income, and forces some who are already near the awful line of pauperism to cross it, and thus puts to death higher aspirations in a class of citizens, and lowers the level of civilization. . . . Indirect taxes are imposed upon people without creating so much discontent as direct taxes, and without occasioning so close a scrutiny of the methods in which the proceeds of taxation are expended, because the mass of men do not realize that they pay taxes every time they purchase dry goods or groceries. Indirect taxes are an underhanded kind of taxation. It is not, then, surprising that they are, in the minds of many, identified with despotism and aristocracy, while there is a growing opposition to them on the part of enlightened democracy."[1]

Is it not surprising, however, that an economist who sees the character of indirect taxation so clearly should recommend those who are so oppressed to extend the list of oppressors from dry goods and groceries to gas lighting, electric lighting, car fares and a long list of other things? Are the rich so poor that it is necessary that one penny out of every car fare paid by "the poor widow" should go to help reduce their taxes, or are they mean enough to want it done?

Suppose that all these industries were owned by the public, and the profits on them were sufficient to pay *all* the taxes, would not the payment of the tax be in inverse ratio to the income of those who pay it? Can any form of tax be more inequitable, more unjust? The short o the first proposal is, then to tax the poor and relieve the rich. Who wants it done?

That which has been said about the slavery of capital is a sufficient answer to the second proposal.

He who assumes to be a scientist and a teacher should be accurate. Professor Ely is reported to have said, without explanation, in his Boston address:

"Gas can be made and sold at a profit for 37 cents I say it can be done, because it is done in the city of Philadelphia; parties supplying the city with gas at that figure."

What do you understand by that? Does it not convey to you the idea that the consumers of gas in Philadelphia are being supplied at 37 cents? Well, the truth is, that the gas works are owned by the city On account of not being supplied with all the latest improvements, the city [illegible] to supply 3,000,000 feet of gas per day. This a carbonated water gas of high candle power, and is mixed with the regular city coal gas for the purpose of increasing the output and improving the quality of the gas manufactured by the city works The [illegible] Philadelphia pays $1.50 for his gas as before. This is held as a sample of the benefits of public [illegible]. This from a teacher of economic science!

[illegible] further, by saying [illegible] who insisted that [illegible] property when the gas [illegible]

[illegible] like that [illegible] that but few [illegible] the fact that [illegible] street car [illegible] business men of [illegible] wealthy [illegible] they found [illegible] American States and Cities, page 271a), came by indirect [illegible]

[illegible] over of [illegible]

charges for gas lighting, electric lighting, street car fares and other products of industry. He advocates an economic theory which must result in the slavery of capital and the pauperization of the people.

Since the days of Hermes, by the use of terms, the people have been deceived.

Dr. Moses of New York offered the following resolution, which was unanimously adopted:

Resolved, That the thanks of the National Electric Light association be and are hereby tendered to the St. Louis Exposition & Music Hall association, through David J. Harris, manager of the electrical exhibit, for the very cordial invitation of Feb. 19th for this association to hold its next convention in St. Louis, and the very generous offer of the use of Exposition hall, and of free exposition space for convention purposes, and, be it further resolved that it is with regret that the association is obliged to decline the invitation above named.

Mr. Morrison moved the reconsideration of the action by which the resolution for the appointment of a committee on state and municipal legislation was referred to the executive committee in order that the appointment be made by the chair.

The motion was seconded and unanimously agreed to.

THE CHAIRMAN: Before we adjourn the chair will appoint upon that committee, under the resolution of Mr. Morrison in regard to the New England exchange, Mr. Alexander, chairman, and Messrs. Francisco, Cram, Woodbury and Perry.

Mr. Mason, Boston, offered the following resolutions, which were unanimously adopted.

"Resolved, That the hearty thanks of the National Electric Light association are hereby tendered to the Exposition society for the valued courtesies extended by it to the association during its present sessions.

"Resolved, That the National Electric Light association desires to record its grateful appreciation of the valued and able services of B. E. Sunny, chairman of the executive committee, who, by the exercise of rare executive ability, has so largely contributed to the success of the meeting in Chicago."

Mr. Mason also offered the following resolution:

"Resolved, That a committee of five, of which Mr. Arthur Steuart shall be chairman, be appointed, whose duties shall be to report at the next session of the association a plan for the incorporation of this body."

The motion was lost.

THE CHAIRMAN: If there is no other business before us, the chair desires to return his thanks to you for the courtesy and consideration you have extended to him, and to say that he will give to his successor all the support he is capable of during his new administration. If there is no other business, I declare this convention adjourned, sine die.

Letter from E. Reckenzaun.

The following communication is self explanatory:

Editor WESTERN ELECTRICIAN:

DEAR SIR:—I have just received a letter from my friend Mr Reckenzaun, London, which unfortunately did not get here in time to be read during the convention. You will very much oblige me by publishing this letter at your earliest convenience. Yours very truly, F. B. BADT.

"I was in hopes of being at the Chicago convention this February, and regret to miss this treat. I do call it a treat, having had the privilege of attending the one at Boston. August, 1887, and at Pittsburgh, February, 1888. I spent the jolliest time at both, particularly at Boston. I shall never forget it, and these conventions gave me a clearer insight into the excellent character of Americans than anything else. There I met them by the hundreds, all jolly, kind-hearted and hospitable; the highest kind of good fellowship and a good deal of practical electricity besides. More good humor than I ever met with on any one occasion in any part of the world. When you attend the meeting of the National Electric Light association rise on my behalf, give them my greetings and shake hands with every one I look upon all of them as dear friends and colleagues, and wish them continued prosperity and success in all their undertakings.

"Very sincerely yours, E. RECKENZAUN."

The Exhibits.

The fact that manufacturers throughout the country applied so promptly for space in which to make exhibits is in itself strong evidence of the general interest taken in the association. That they made such large consignments of costly machinery to illustrate all the features of electrical work is a matter for general congratulation.

The exhibits constituted one of the most interesting and significant features of the convention. To the executive committee, and especially to B. E. Sunny, chairman, praise is due for securing a class of exhibits which would add to the general interest in the convention. In this work, as in every branch of its labors, the committee has worked early and late.

Below will be found brief descriptions of a [illegible] exhibits, which still may be seen.

The [illegible] pressure recording gauge and [illegible] for steam, water, gas, oils, [illegible]

The [illegible] Insulating and Waterproofing company of New York is displaying its special [illegible] wire and cables in department A. The company is represented by A. C. Shaw of New York and J. R. Burdick of Chicago.

The bare and insulated wires displayed by Holmes, Booth & Haydens of New York came in for their share of attention.

Ed Williams has a small specimen of his fine automatic engine. Mr. Williams has the contract to furnish the engines for the Auditorium building.

The Chicago Rawhide Belting company has a full line of its goods on exhibition in department B. This company was represented by W. H. Preble.

W. C. Lyman, manufacturer of the steam condensing vacuum exhaust pipe head, at 49 Michigan street, Chicago, is represented in the exposition.

R. H. Salter and C. A. Landy are representing the Eureka Fire Hose company of New York, manufacturers of the Eureka belt and appliances for belting.

William E. Quimby, secretary of the Weston Electrical Instrument company, Newark, N. J., has a full line of voltmeters on exhibition in department B.

Fred. H. Whipple, the author of "Municipal Lighting," "Water Supply," and other books, has a stall in department A for the exhibition of his works.

E. B. Preston & Co., manufacturers of fire department supplies, etc., Chicago, have an exhibit of beltings in the main hall. David B. Kelly is the representative of the house in charge.

Lewis W. Davis, electrician of the Queen City Electric company, Cincinnati, O., has a number of Queen City motors, which were employed in operating fans and dental engines.

The Bernstein Electric Light company of Boston is displaying its series incandescent light in a practical way by lighting several parts of the hall. H. B. Cram, the treasurer, is in charge.

George H. Wood, representing the North American Underground Electric company, is exhibiting the Johnstone Underground Distributing system, which can be found in the main hall.

An interesting display of outfits for passenger and freight train alarms, burglar alarms and steamboat alarms was seen at the headquarters of Parrish Bros. & Peck, of Detroit, Mich., in department B.

The Eddy Motor Company has a 10 horse power machine on exhibition in department A. The working of the machine is explained by M. E. Baird and A. D. Newton, who are representing the company.

The Stilwell & Bierce Manufacturing company of Dayton, O., is exhibiting the Victor Turbine, the distinctive feature of which is that it has a horizontal shaft, and is especially adapted for driving dynamos.

Goulds & Austin, western agents for the New York Belting and Packing company, have an exhibition of their beltings, brass goods, etc., in department B. R. W. Caldwell, jr., is present representing the company.

A. I. Wright, manager of the Reliance Gauge company of Cleveland, is surrounded in the art hall by a large exhibit of his water columns and other appliances for the safe piping of water into boilers, etc.

Cook & Canny of Detroit have on a table in the art gallery several models of their underground conduit built upon the Cook system. The device was patented by Geo. W. Cook last fall, and is already meeting recognition.

The Pond Engineering company, St. Louis, is displaying its system of steam plants for driving dynamos in central stations, railway stations and power stations, and its many excellent features are attracting considerable attention.

The Wm. Powell company of Cincinnati has in the art room, upon a neat, blue etagere, a pretty exhibition of its oil and grease cups for dynamos and lubricators for engines. The cups are of glass with brass mountings, with signal levers attached to indicate when flowing and the speed

of oil delivery. They are so constructed as to shut off the flow when the machine stops. The cup is new and a good thing. Mr. Powell himself is in charge of the exhibit.

The Mosher Tubular Packing company has an elaborate display in the main hall under the supervision of Charles L. Anderson, who claims simplicity, practicability, effectiveness and economy in the use of this style of packing.

In the large space near the south alcove of department A the C. & C. Electric Motor company of New York has its fine exhibit. H. L. Lufkin is in charge and has a half dozen 1-horse incandescent dynamos, one 3-horse arc motor and a large quantity of appliances.

The Detroit Motor company, represented by A. A. Robinson, has a full line of motors on exhibition near the entrance of exhibit A. These motors range from 1-20 horse power to 5 horse power. All were connected up and two were used to operate a sewing machine and lathe.

The Knapp Electrical works of Chicago, the New York Insulated Wire company and the American Electrical works of Providence, R. I., are making a general display of wires, cables, tapes and incandescent cord. These displays are among the most elaborate exhibits of wire, in the collection.

Pettingell, Andrews & Co. of Boston, Mass., are making a specialty of the following articles in their display: K. W. cut-out, Johnson arc lamp stay, Haynes' double-pole switch, Royal 5-ampere switch, the new lock and burglar alarm, Boston ceiling button, novelty pocket screwdriver.

Locke Bros., of Salem, Mass., are exhibiting their gauge testing damper regulator in the main hall. The device is asserted to be the best and safest appliance of its kind, regulating more dampers in better shape than anything else of its kind. It has already received medals and awards. H. B. Ham is in charge.

The Schultz Belting company claims that "it belts the earth and makes the moon spin like a top." The specialty is a leather covered pulley that is seamless and without rivets. The wheel of the pulley is cast with a groove into which the edge of the leather is fastened. It is solid and compact. J. A. J. Schultz, of St. Louis, the maker, is present.

The Waters-Sweeney telegraph and telephone switch seems to be a desirable adjunct to the science of electric communication. The company has an exhibit in department A under the supervision of R. G. Sweeney, one of the inventors. The machine is very compact and simple in mechanism. Several testimonials of its value have already been received.

The Phœnix Glass company has a fine assortment of cut-glass globes for incandescent and arc lights in every conceivable style. Some of the most elaborate designs turned out by this house are displayed here and they are marvels of taste and workmanship. In decorated shades and costly globes the Phœnix company has outdone all its former attempts.

The Excelsior Electric company, represented by F. W. Horne, is in department A with a large exhibit. It has one each of 1, 2, and 10 horse power arc motors, a 50-light incandescent dynamo and two 15 arc light dynamos, double and single arc lamps, steamboat focusing light, locomotive headlight and photographing focusing, as well as a large variety of other appliances.

Gen. Green B. Raum and his phonograph had original space in the Thomson-Houston enclosure, but the noise of that busy spot drove him to a less turbulent though quite as prominent location at the side of the Waltham Watch company's exhibit in department B. The phonograph, although not an electrical appliance, is run by an electrical motor, and is among the most interesting objects to be seen.

Almost in the center of the hall, near the Detroit exhibit, the Pumpelly company of Chicago has a fine display of its storage batteries. The company has its headquarters at 229 La Salle street, under the Grand Pacific, and is represented upon the spot by Geo. W. Marble. He makes many claims of superiority for the Pumpelly battery. It is lighter, he claims, more compact, of the least internal resistance, [illegible] the best material and longer lived, and has the best possible adjuncts in every part.

On either side of the main entrance stand two huge posts with projecting arms like gibbets save that the arms are longer than the uprights. There are specimens of Brady's Electric Light Mast Arm, manufactured at New Britain, Conn. Thos. H. Brady, the inventor, is here in person. When fully equipped, the arc lamp hangs from the arm twenty-one feet away, and has storm protector, spark arrester and other necessary accessories.

The Central Electric company of Chicago and the Okonite company of New York are making a joint display in department B. The Okonite wires, cables, lamp cords, tapes and tubing occupy a prominent place in the exhibit, as do also the Candee aerial wires and Manson tape. Butler hard rubber goods in tube, rod and sheet rubber, the Cleveland arc and incandescent switch, and the Lockwood ammeter and polarity indicator are displayed, as well as a full line of electric supplies and construction tools. W. W. Low is in charge of the exhibit.

John Boylston represents the Chicago Engineer Supply company, of 18 Dearborn street, Chicago. In the center of the main hall he has a fine exhibit of specialties. There are samples and specimens of their varied goods in every line. The house deals exclusively in engineers' supplies of every description, fine lubricating oils, iron pipe, fittings, tools, etc., with repair parts for pumps always on hand, as well as the Detroit lubricators. The firm is also agent for Garlock's elastic ring packing, sheet rubber, asbestos, cotton waste, all sorts of packing, etc.

The exhibit of the National Carbon company of Cleveland, under the supervision of W. H. Lawrence, president of the company, and W. C. Hayes, treasurer, is fine in its line. The company shows molded, forced and cored carbons, either plain or copper plated, suitable for all systems of electric arc lighting; carbon plates of all sizes and carbon brushes, disks, cups, etc. Among the rest is what the company asserts to be the largest forced carbon in the world—21 by 50 inches. These huge carbons are used for smelting aluminum. Seven of them are bound together by cast-iron bands, conveying the electric current into the retort furnace for extracting aluminum from clay.

The exhibition of the Non-Magnetic Watch company of America, comprising a great variety of watches, attracts much attention. This company manufactures the finest line of timekeepers in the world. All contain the celebrated Paillard non-magnetic balance and spring, are full non-magnetic and are not affected by powerful magnetic fields. The line includes all styles of complicated and fine watches, as well as the medium grades of American made movements. The excellent results in adjustments to temperature obtained with the Paillard balance and spring cause the manufacturers to claim that the Paillard non-magnetic is the finest watch in the world. The space is handsomely furnished. The exhibit is in charge of R. S. Hubbell, assisted by C. R. Botsford.

The Ashton Valve company of Boston has a conspicuous stand for its exhibit under the care of A. J. Hewlings, the Chicago manager. The specialty of this company is the "Pop" safety valve for stationary, marine and locomotive boilers. It also has water relief valves for pumps and standpipes. Mr. Hewlings claims for the "Pop" a perfect protection from boiler explosions by overpressure. It is only just to say that Hartford's ill-fated hotel did not have the "Pop." The appliance is such that if the pressure exceeds that to which the boiler is limited the valve opens and releases the steam, closing again automatically and promptly at the working pressure required.

In the main hall, near the entrance, is an elaborate display of wire by the John A. Roebling's Sons company of Trenton, N. J. T. S. Gordon is in charge of the exhibit. One of the attractions at this exhibit is a two-mile reel of B. & S. copper wire, which is adapted to overhead railway systems. Other features of the display are insulat[illegible] magnet wire [illegible]

[illegible] of Chicago, which is in section 1, department A. T. W. Neely, who is in charge of this [illegible] number of chairs. On every side are displayed electrical instruments, tools and supplies. The display of electrical tools on one section of the wall is as complete as it would be possible to make it. On another section is a display of fifty-one Sawyer-Man lamps in all kinds of sockets. On another board are arranged incandescent cords and large tools. In the show cases testing instruments and specialties are displayed. Incandescent shades, okonite wires, P. & B. wire and cable, high insulation brackets, brush copper, vulcanized fiber, an automatic arc lamp suspended from the center of the dome—all these and many novelties are displayed in this booth. All the lights displayed in this booth are governed by the new automatic ground-switch.

A new automatic high tension dynamo is on exhibition in the Sperry display in Department A, and the working of the machine is explained by D. P. Perry, manager of the Sperry Electric company. This dynamo furnishes power for ten of the new style Sperry lamps suspended from a bracket. These lamps are constantly cut in and out of circuit in order to show the working of the regulator. Any number of lamps from the full capacity to a single lamp or none at all, in fact, may be switched in or out without varying the regularity or steadiness of the light. All other prominent points of interest in this system are displayed to their full advantage. The Sperry lamp is also used in showing several styles of new lamp hangers in other displays, while the improved Sperry low tension lamps illuminate the space occupied as a depot for the electrical railroad. The current for the experiments at the display of the Cobb Wire company is furnished from the Sperry dynamo. The practical working of the Sperry switch-board is also illustrated.

The first exhibitor to complete its display was the Woodward Electrical company of Detroit, which presented the Detroit storage battery. This company had an interesting installation of its batteries in the main hall, almost directly opposite the entrance. The batteries were utilized to light incandescent lamps, furnish power for motors, etc., in the Western Electric company's display, section 18, department A. A Thomson-Houston motor and a United States dynamo were used in charging these batteries. Over the display of batteries in the main hall is a large letter D, in which were arranged a number of incandescent lamps. These are known as the Seel lamp, and were made in Germany. A similar device is displayed in the Western Electric company's booth. Sawyer-Man lamps were also fed from these batteries in the Western Electric company's display, which contained a full line of telegraph instruments, electric bells and supplies. In the same section were the Washburn & Moen Manufacturing company's wires, the western agent of which is the Western Electric company.

The H. W. Johns Manufacturing company of New York, represented by Robert Coleman, has an extensive display in department B, consisting of asbestos curved sheathing, building felt for lining buildings, fire and water proof sheathing for the same purpose. These goods are also adapted to use in breweries, stills, etc. The vulcabeston goods which attract so much attention here are made of rubber and asbestos. This compound is found in a variety of forms, including tubes, battery cells, washers, insulating parts for dynamos, armatures, brushes, insulating water-proof and fire-proof commutator heads. The indurated fiber conduit, however, is the principal article in the display. It is made of

wood pulp pressed into shape and treated with asphalt and certain properties of coal tar and bitumen. This conduit is designed for underground electric wires, and was therefore given more than ordinary attention at this convention. It is claimed in behalf of the conduit that it is not only light, strong and durable, but is almost a perfect non-conductor, and is unaffected by thermal changes. Moreover, it is claimed, it is cheaper than wrought-iron pipe.

Among the most interesting exhibits to experts is that of James W. Queen & Co., of Philadelphia, which is displayed in connection with the Thomson-Houston company, in Department A. This display contains a rare collection of valuable testing instruments, and is said to be the most costly that has ever been shown at an electrical exhibition in this country. Prof. William A. Anthony, formerly of Cornell University of Ithaca, N. Y., personally recommends many of these instruments, and his certificate is highly prized by the exhibitors. Probably the most highly prized instrument in the collection is the Thomson balance, invented by Sir William Thomson, president of the Institute of Electrical Engineers, of London, England. There are only a few of these instruments in this country—in fact they are so costly that few electricians can afford to possess them—and that at the exhibition is said to be the first displayed in public in this country. Queen's ohmmeter is another highly-prized testing instrument. It combines a slight wire bridge, rheostat, galvanometer and battery in a box 10x10x6 inches. In addition to these specialities, there is a full line of testing apparatus of every description that will repay a careful inspection.

The Thomson-Houston company is running an electric railroad, lighting the building with arc lights, lighting the assembly hall with incandescent lamps and furnishing light and power to a number of exhibitors. The company's exhibit stand is in the center of department A and encloses about twenty-four feet of space. Within the enclosure is a small motor which cuts out and switches in sets of colored incandescent lamps above the stand. This produces a series of changes in red, blue, green, violet, etc., like auroral flashes, the beautiful effect of which is readily conceivable. The track upon which the motor car is operated runs from one end of the building to the other, a stretch of 900 feet. The car, which was manufactured in St. Louis, is a handsome, yellow bodied coach, not unlike the ordinary street car. It takes its power from overhead and can run at any speed up to 30 miles an hour. The car can be stopped within its length. It ran back and forth during the convention and gave gratis excursions to all visitors. The exhibit is in the care of Mr. Soden, while H. S. Manning has charge of the machinery. This is quite extensive, comprising a 100 horse power engine, with Eclipse friction clutches, two 400-light incandescent dynamos, one 40 horse power railroad generator and one 50-light arc dynamo of 2,000 candle power to the light. The Munson Belting company and the Eclipse Wind Engine company furnished the [illegible] respectively, for the Thomson-Houston plant in the hall.

The list of exhibitors was as follows: Sperry Electric company, Callender Insulating & Manufacturing company, Chicago Rawhide Belting company, Eddy Electric Man- [illegible] Underground Cable company, Non-magnetic Watch company, [illegible] New York Insulated Wire company, American Electric works, American Waltham Watch, Okonite company, [illegible] Electric company, [illegible] pany, Bliss Shafting & Pulley company, Bentley [illegible] Electric Light, George F. Card Manufacturing company, Fitz E. Culver & Co., Rice Automatic steam engine, John A. Roebling Sons company; Union Brass company, Cincinnati; Thomson-Houston railway, Thomson-Houston Electric company, Woodward Electrical company, WESTERN ELECTRICIAN, *Modern Light and Heat*, *Electrical World*, *Electrical Review*, *Practical Electricity*, *American Engineer*, *Science*, *Electrical Engineer*, Munson & Co., Ideal Engine company, Phœnix Iron Works company, Giles' magnetic shields, Rice Engine company, New York Safety Power company, Hill clutch, Excelsior Electric company, Western Electric company, Simplex Electric company, D. C. Hood, William Power company, Goulds & Austin, National Carbon company, Eastern Electric company, Schultz Belting company, Brownell & Wright Car company, Weston Electrical Instrument company, Bernstein Electric company, Home Engine company, Mosher Tubular Metallic company, Ureka Fire Hose company, Prentiss & Co., Pumpelly Storage Battery company, Ide engine, Phœnix engine, Rice engine, Buckeye engine, Williams engine, New York Safety power engine, Cook & Canny Underground conduit, Parrish Bros. & Peck Electrical company of Detroit, National Automatic fire extinguisher.

The Geo. F. Card Co., Cincinnati, had a prominent place near the center of the building for their exhibit of specialties. He has a canopied booth strung with nearly 100 incandescent lights, in addition to which he supplies twenty lights for section B. To operate these he has a 5-horse power and 2-horse power arc motor, and two incandescent dynamos of 60 and 25 light, respectively. In addition he displays a new electric meter. The exhibition is in charge of Capt. J. F. McClure, the manager, and E. B. Richards, electrician. The E. P. Gleason Manufacturing company of New York occupies the south alcove of section A with a large display of its light fixtures. The house makes a varied show of electroliers, insulating joints, tin, brass and glassware for arc and incandescent lighting. In glassware the firm has a specialty, exhibiting every form and device of plain, colored, etched, opal, sandblast, etc., throughout the list. Attention is directed to a new arc globe with such a patent annealing that sudden changes of temperature, even from 100 degrees to a dash of rain, will not break it. The exhibition was in charge of Wm. F. Collins of New York and J. G. Hawkins of the western branch, Gleason & Bailey Manufacturing company at 233 Lake street, Chicago. H. E. Duncan came from Boston with the largest watch in the world and the full and brilliant exhibit of the Waltham Watch company of Waltham, Mass. The big watch is a horse-timer, and its only existent twin-brother is in Australia. It was invented by the Waltham company, and the first specimen was snapped up by the Australian racing people, a committee of whom saw it in this country. The watch has a dial three feet wide, and keeps the minutes and seconds down to a fifth of the latter. Its position is on the front of the judge's stand, and is started by an electric button when the horses catch the word, and is stopped in the same manner the instant the leader's nose passes under the wire. The time of the heat or race is thus registered in plain sight of the grand stand. Besides this wonderful device the great watchmakers have a full line of their timepieces in all their varying beauty and ingenuty. Their greatest novelty in the line of pocket watches is a marvel. It is what the company calls the stone watch. The frame is made of hard stone —quartz or agate. Mr. Duncan has one of the latter, full ruby-jeweled, and with double glass case, so that holding it to the light and peering through the translucent quartz the entire mechanism can be seen. In addition the exhibition comprises pocket stop watches of every material and grade, and will be altogether one of the most attractive of the exhibits.

Convention Notes.

Reels of submarine electric light cables, for both high and low tension circuits, the Candee wire with its wide reputation, the Manson tape put into the market for the first time at this exhibition, the Okonite tape and all the Okonite specialties make up the interesting collection of the brilliant Okonite exhibit in department B. As if this fine collection were not enough the full dress darkey who has stood at this booth was Thursday engaged in dispensing fine and fragrant boutonnieres among the members of the association and representatives of the press. Capt W. L. Candee, treasurer of the company, is present at the exhibit.

The Schultz patent leather covered pulleys are an attraction of department B. Pulleys heretofore have been drilled or stitched in being covered, but the cover is put on when green and fastened with prepared grooves, after which it is permitted to draw and fit itself. Thus both the face and edge of the pulley are covered and there is nothing to cut the belt. Mr. Schultz, the inventor, is present in person showing his valuable device.

The National Electric Manufacturing company, of Eau Claire, Wis., is giving an exhibition second to none. It is running two dynamos in the north end of the hall, one of which operates 250 lights, while the other gives power to 3 Thomson-Houston motors, five Belding motors, one 10-horse Eddy motor, and the Pumpelly storage batteries. In addition to these machines, the exhibit contains a 1,000-light alternating dynamo for incandescent lighting. The exhibit is fine in itself, and becomes remarkable when it is considered that the company has been organized only two months. The progress is astonishing. W. K. Freeman, the genial manager of the company, and Carl Kammeyer are enterprising business men.

The exhibit of the Detroit storage battery by the Woodward Electrical company is one of the most attractive features of the exhibition. The important part which the storage battery is assuming in the question of electric lighting makes this display all the more important, as it is a practical illustration of the possibilities of these batteries. The Woodward company has two installations, one of twenty-seven cells and another of twenty six cells. These are running thirty incandescent and fifty volt lamps in the main hall. Current is supplied from one cell for six train signals in the display of Parrish Bros. & Peck. These signals are connected up the same as two train coaches wired for electric lighting, and the constant pulling of the bells keeps a throng constantly about the headquarters of this company. The Woodward company is also supplying current from four cells for running a Detroit motor of one quarter horse power, which is utilized for operating sewing machines and dental machines. Frank B. Trout, general manager of the Woodward Electrical company, who is in charge of the display, says in addition to the uses to which the Detroit battery is put at the exhibition, it can be most advantageously utilized for operating street cars. Tests have been made in Detroit, Mich., and Brooklyn, N. Y., which have proved satisfactory to the company and satisfied the citizens of these cities that the solution of the problem of rapid transit lies in the storage battery. Mr. Trout is very enthusiastic over the success of the battery and the impression it has made on the electric light men in attendance at the convention.

On the afternoon of Wednesday, Feb. 20, at the close of the daily session of the convention, a large party of visitors and delegates inspected the electric lighting of the residence of Potter Palmer, on the Lake Shore drive, at the invitation of the representatives of the Electrical Accumulator company, which has recently installed a large plant for Mr. Palmer. Considerable interest was manifested on account of the novel character of this installation. Power for this plant is supplied by an Otto gas engine, capable of developing 21½ actual horse power. The power is transmitted to a dynamo of the United States company's make by means of a counter-shafting on which is placed a heavy flywheel to steady the motion, which would, otherwise, be slightly irregular on account of the fact that the gas engine takes gas at every second revolution. The dynamo has a capacity of 75 amperes and e. m. f. of 125 volts, which may be increased slightly if desired. This dynamo charges two series of 56 cells each, of the Electrical Accumulator company's 15A type. These two series are connected in parallel, and, when fully charged, are capable of supplying 100 16-candle power lamps for ten hours. The dynamo is capable of supplying 120 of the same lamps, making the total normal capacity of the plant 220 lamps, which may be increased to 250 by allowing the accumulators to discharge at their maximum rate. The switch-board is fitted with all of the latest appliances, and is so arranged that a number of combinations may be made. First. The dynamo may supply lamps direct. Second. The dynamo may charge the battery and supply light at the same time. Third. One-half the battery may be charged while the other half is discharging. Fourth. The accumulators alone may be used for supplying lamps without the aid of the dynamo. Fifth. The accumulators and the dynamo together may be called into service to operate in conjunction, when the maximum number of lamps is desired. The accumulators are provided with means for equalizing the charge and discharge, for preventing injury to the cells by overloading, and to prevent the cells from discharging into the dynamo, if its electromotive force should fall below that of the battery. The plant is located in the stable, and current is conveyed to the residence, nearly 200 feet distance, by means of Patterson underground cable, laid in a substantial wooden box, which is filled with a mixture of pitch and sand. This same conduit brings back a pair of pressure wires from the house, which are connected to a potential indicator in the dynamo room, in order that the attendant may regulate the candle power of the lamps without difficulty. This is said to be the first plant in this country in which so large a gas engine has been used for incandescent lighting in connection with accumulators. The plant so far is giving perfect satisfaction, and from the fact that power and current are available at all times, it is expected that the plant will prove a model for private house installation.

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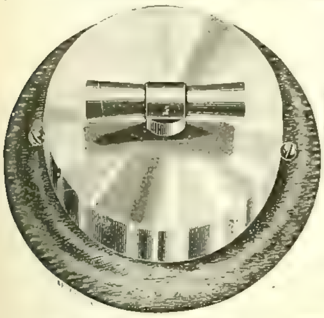

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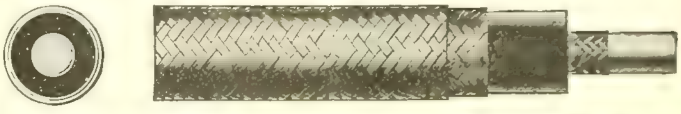

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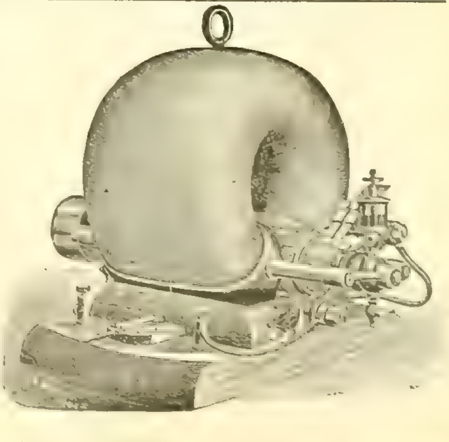

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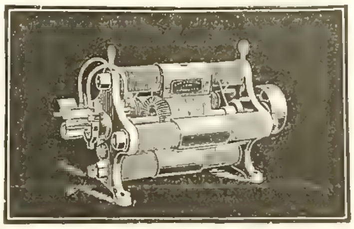

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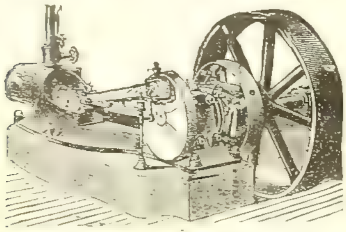

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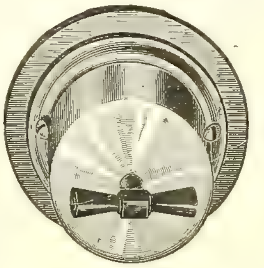

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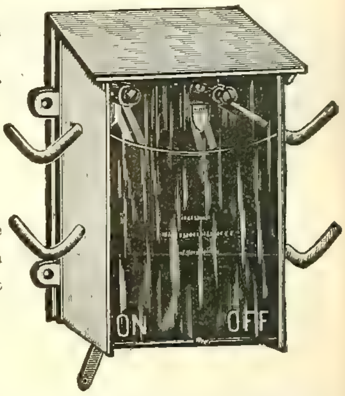

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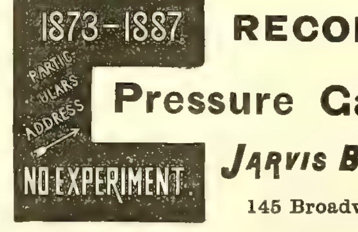

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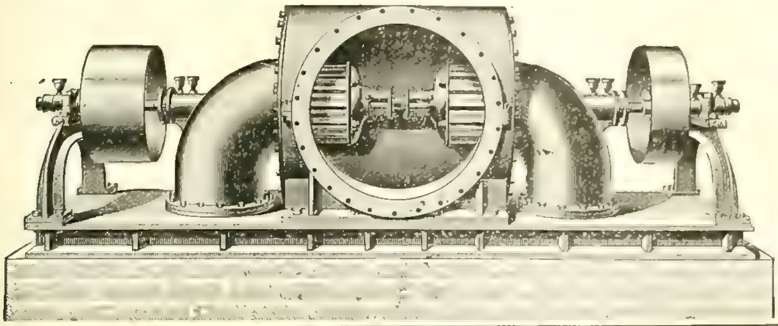

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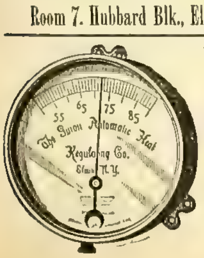

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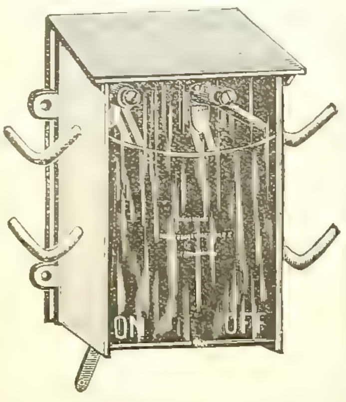

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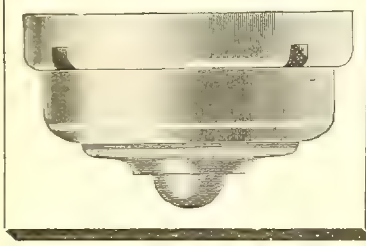

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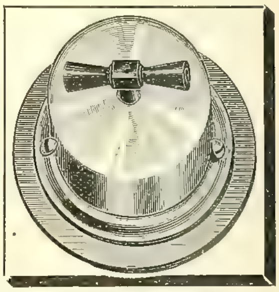

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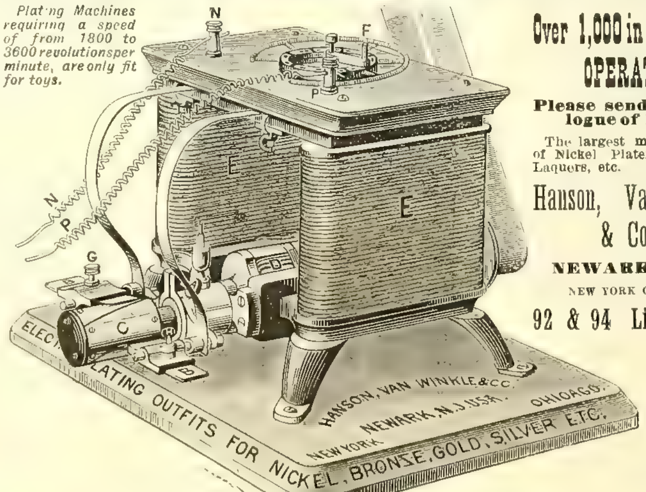

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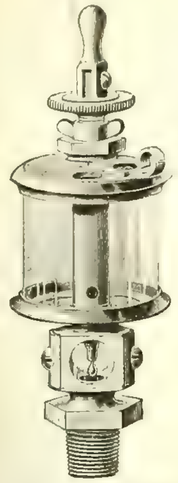

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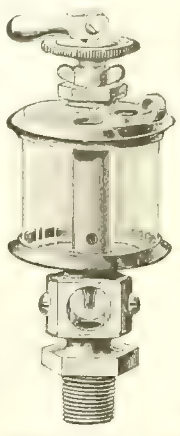

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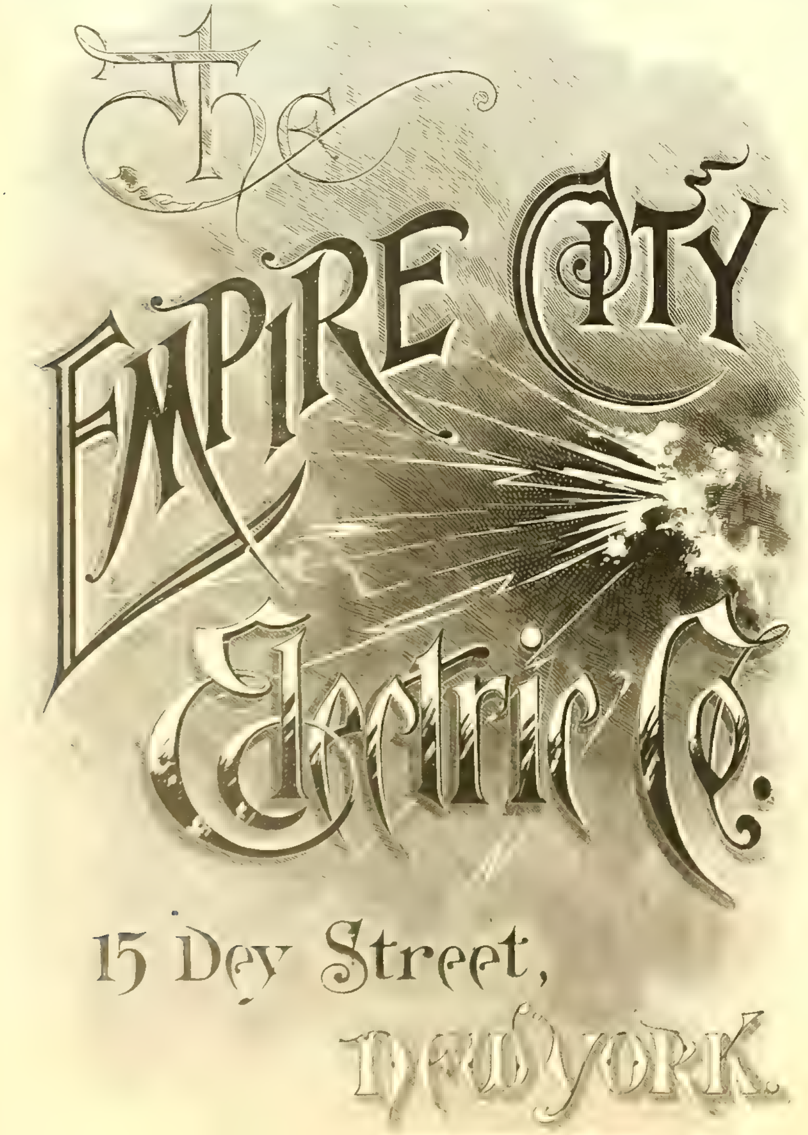

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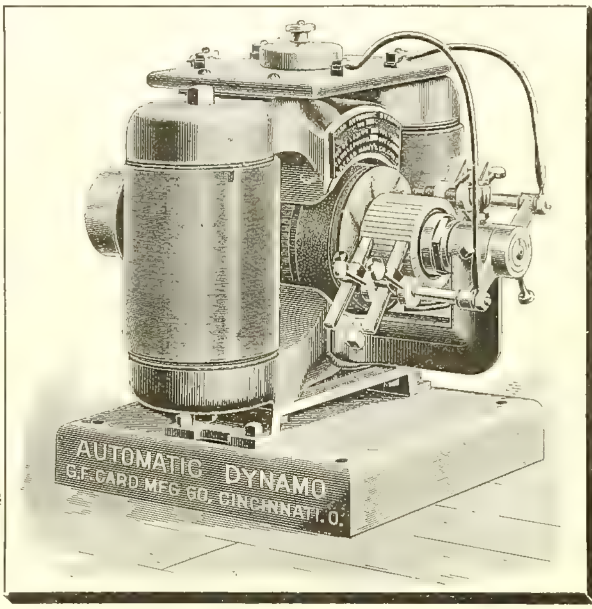

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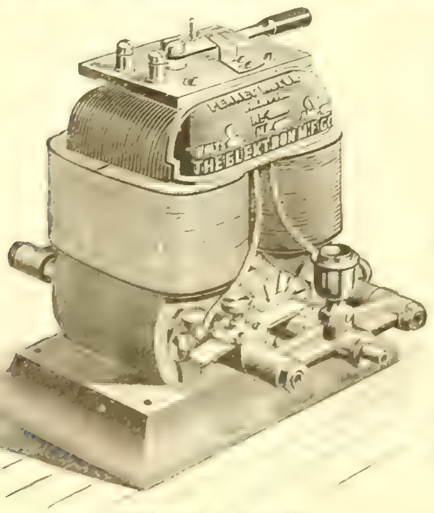

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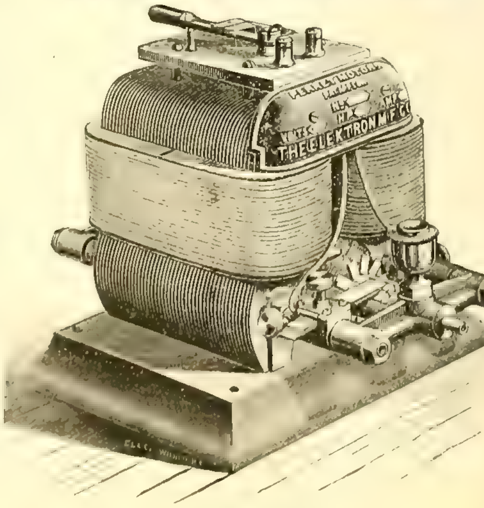

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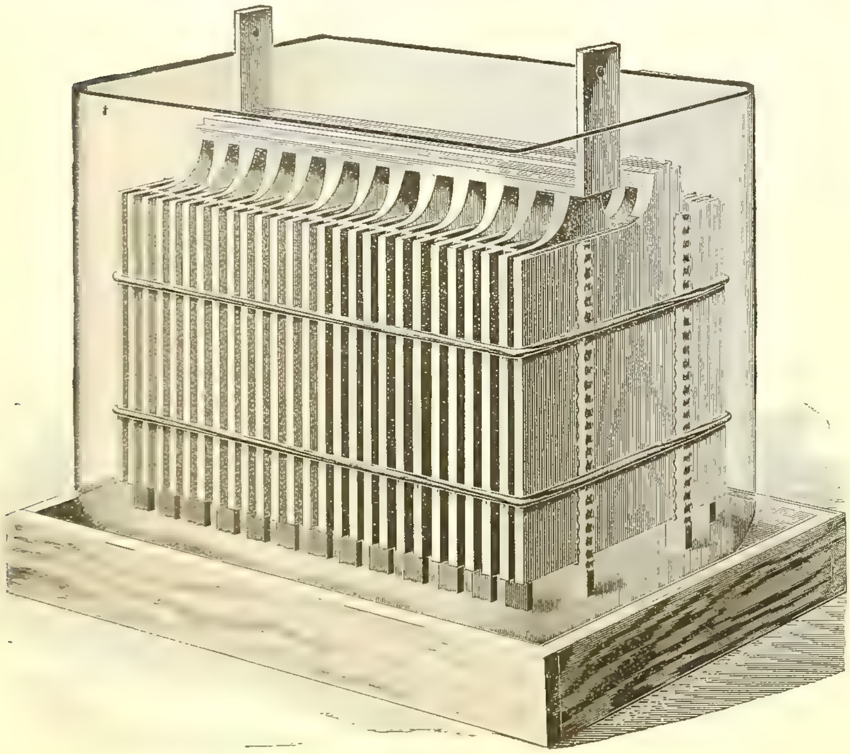

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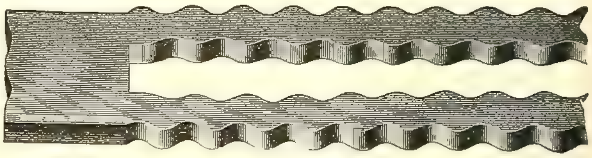

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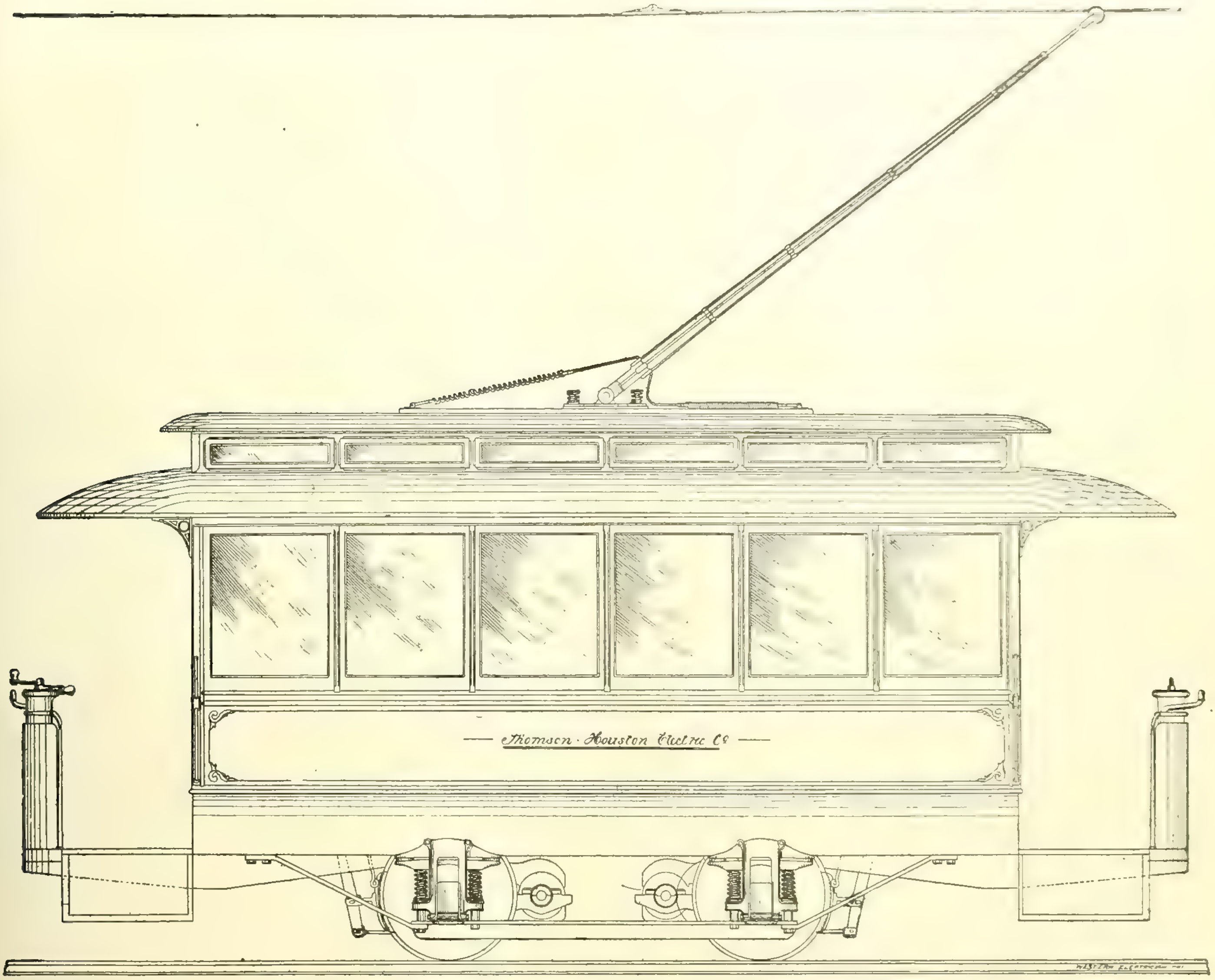

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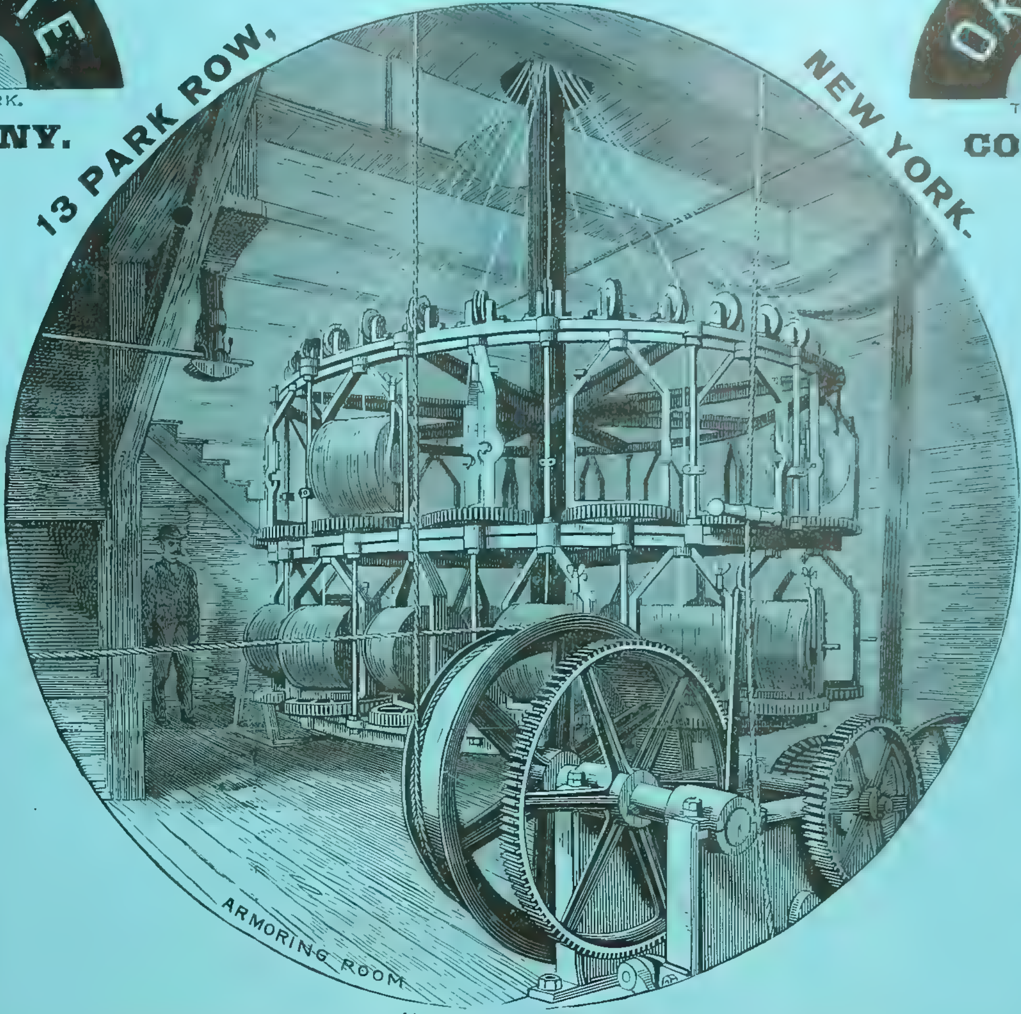

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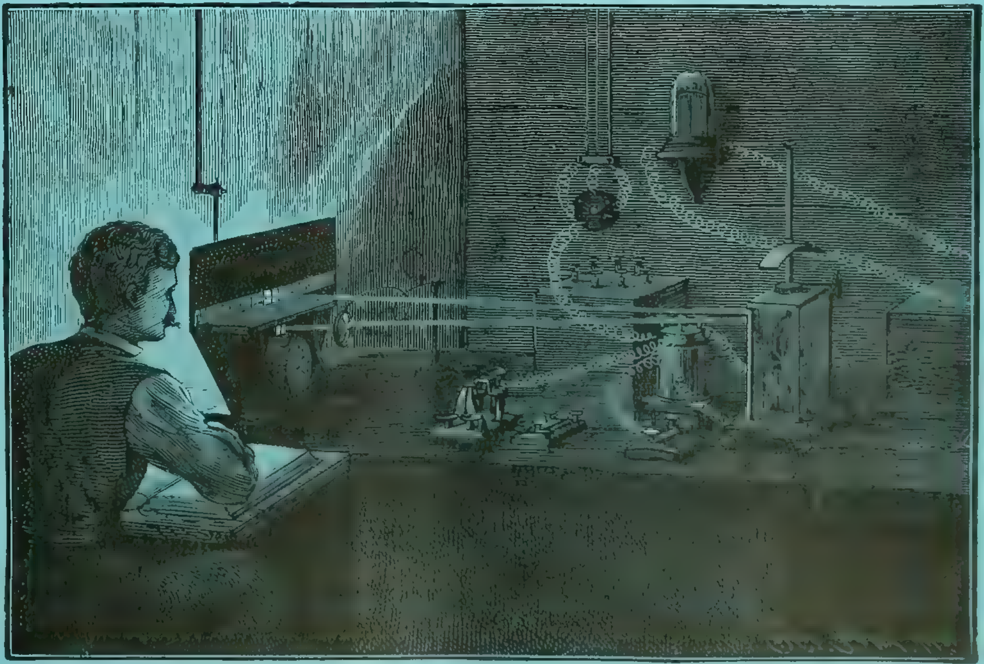

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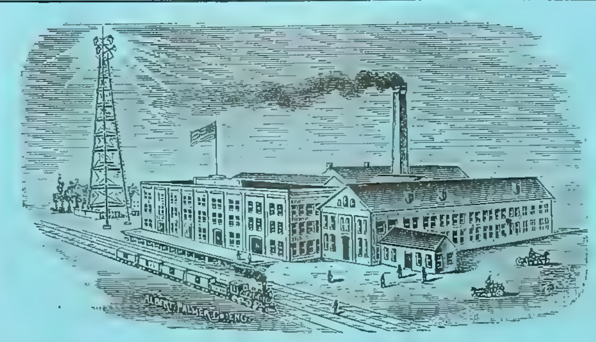

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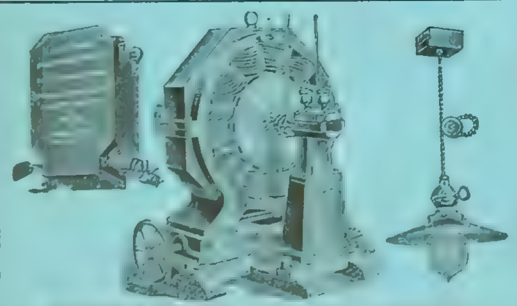

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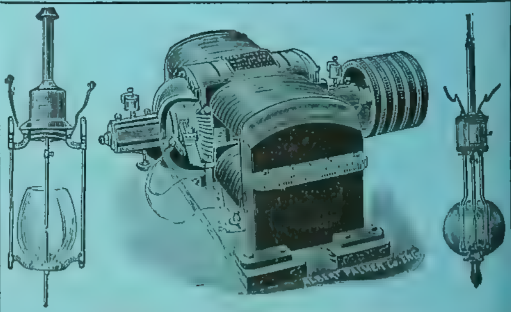

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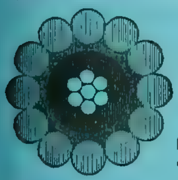

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All Sizes *Lead Encased Wires.*

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Locomotive Safety Valve,
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THE ASHTON VALVES Have a wide reputation as being the most perfect of their kind.

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THEIR WATER RELIEF VALVES For Pumps, Stand Pipes, and Steam Fire Engines are the best now in the market.

Simple in construction, Automatic in action, Perfectly Controlling the Pressure of the hose at whatever speed the engine or pump is working.

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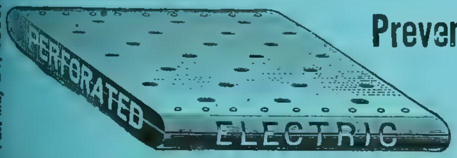

Prevents Air Cushions.

GUARANTEED FOR

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Fire-Proof and Weather-Proof

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CUT SHOWING STYLE OF INSULATION.

A.—Copper Wire. *B. B.*—Two Braids, saturated with Fire-Proof Insulation. *C.*—Braided Cotton, saturated with a *Black*, WEATHER-PROOF Composition.

Approved by New York Board of Fire Underwriters. Samples furnished upon application. Pure Electric Copper Wire, bare and covered, of every description.

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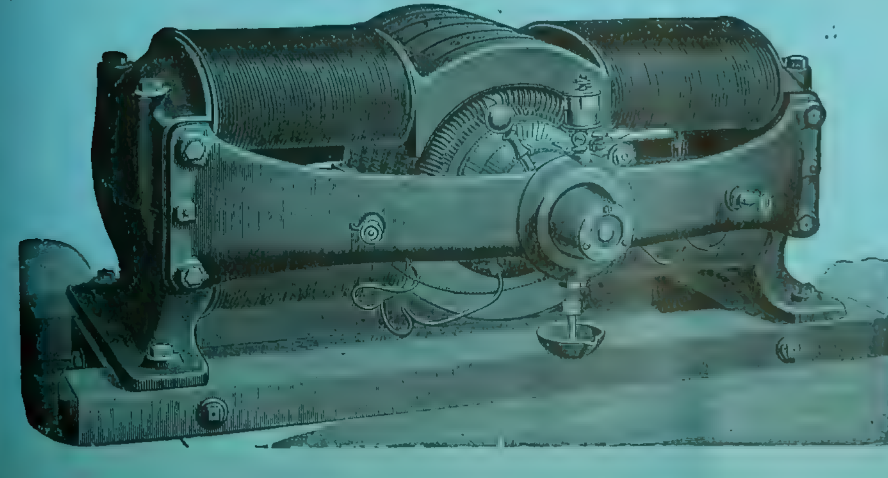
Sole Owners of all the Patents and Inventions of Charles D. Jenney (known as the Jenney System) and Sole Owners and Manufacturers of his



Improved Dynamo, Lamp & Electric Motor.

In all desirable features of Arc and Incandescent Lighting the Jenney System leads. Simple, durable, economical, steady, brilliant and penetrating. In these essentials it challenges comparison

Estimates Promptly Furnished for Erecting Electric Lighting Plants for Cities, Companies or Individuals.

PRICES FURNISHED FOR THE JENNEY ARC OR INCANDESCENT SYSTEMS, OR FOR BOTH COMBINED.

The Jenney Incandescent Dynamos are self-regulating, and permit the turning on and off of one or all of the Lamps at will.

This Company gives special attention to furnishing Mills, Shops, Factories, etc., with Individual Plants.

SEND FOR PAMPHLET ILLUSTRATING AND DESCRIBING THE SYSTEM.

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The Thomson-Houston Electric Co.

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ONLY PERFECT AUTOMATIC SYSTEM

—OF—

Electric Arc-Lighting

IN THE WORLD.

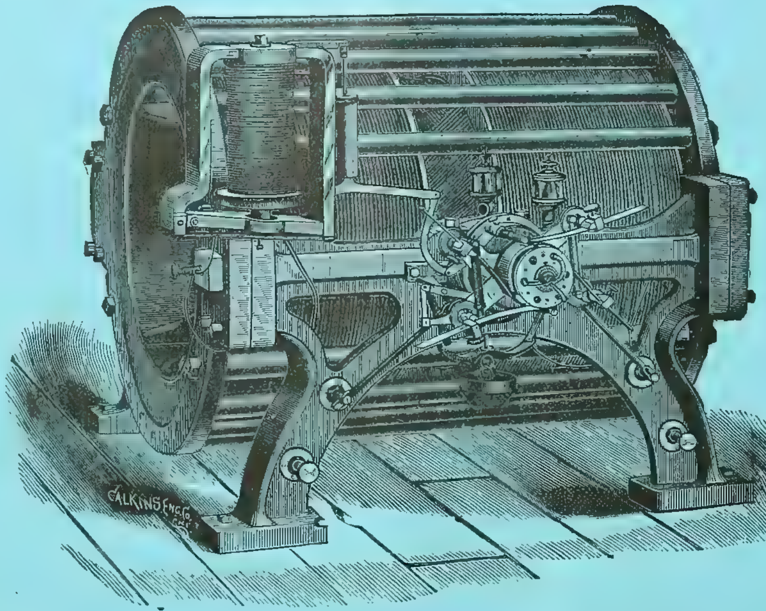
SERIES LAMPS

—FOR—

Arc-Circuits.

These Lamps have repeatedly shown their superiority under test.

First Medal: Best Arc-Light, Louisville, 1883,
First Prize: Best System of Arc-Lighting, Cincinnati Industrial Exposition, 1883.

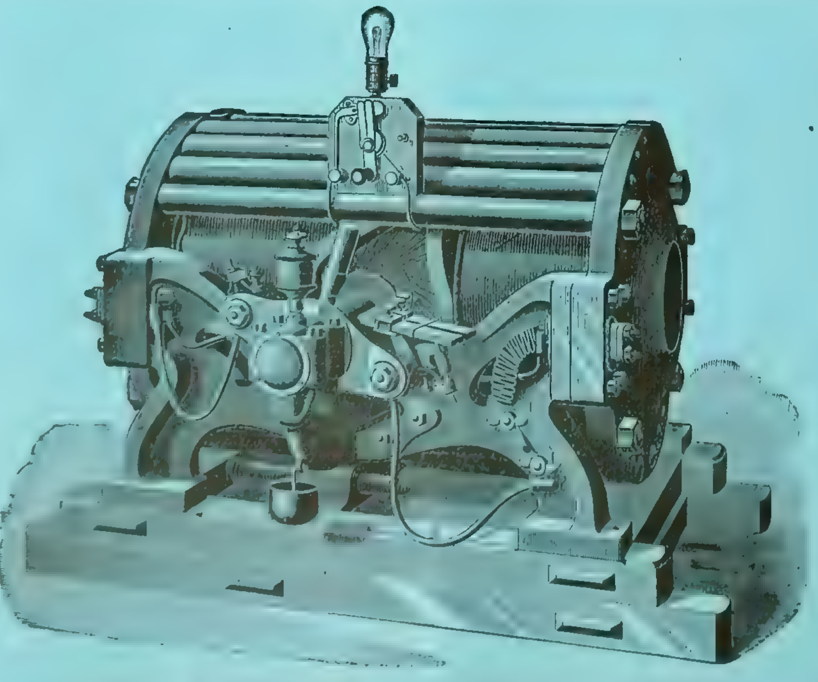


This Company was given the only Gold Medal awarded at the International Inventions Exhibition, at London, August 11, 1885, FOR ARC-LIGHTING.

ALSO MANUFACTURERS OF **INCANDESCENT DYNAMOS** FOR DIRECT LOW TENSION

AND ALTERNATING CURRENT LONG DISTANCE INCANDESCENT LIGHTING.

These dynamos are automatic in their regulation and will maintain a uniform light with all or any portion of the lights in circuit. No other Incandescent Lamp is so perfect and durable. Our Incandescent systems are complete and include every appliance needed by the customer.



SELF GOVERNING ELECTRIC MOTORS

all sizes for the transmission of Power. Plans and estimates for all kinds of Arc and Incandescent Lighting and Power Plants.

ELECTRIC LIGHT SUPPLIES

OF EVERY DESCRIPTION.

Owing to the Automatic and Self-Regulating features of the **DYNAMO MACHINE** (broad and valid Patents for which are owned by this Company) sufficient saving is effected in power, attendance and repairs as compared with any other system, to more than pay interest on the entire cost of plant.

SIMPLEX LINE WIRE

NO. 1 INSULATION.

All Who Have Used it Pronounce it the Ideal Line Wire.

MALDEN ELECTRIC CO.,
MALDEN, MASS., Feb. 8, 1889.

SIMPLEX ELECTRICAL CO., Boston, Mass

Gentlemen:—I take great pleasure in recommending most heartily the Simplex wire for the purpose of electric light construction. We are using over 160 miles of this wire in the territory of Malden, Melrose, Everett and Medford. We believe it to be far better than any other in the market, and in the end most economical for our purposes. We have made careful tests of it in comparison with other wire, and should be unwilling to use any other where trees are numerous and the foliage is dense, or, indeed, for any general construction.

Yours very truly, H. A. ROYCE, Treas.

CORRECT VIEW OF A TREE LIMB CHAFED BY THE

Simplex T. Z. R. Insulated Wire.

NO. 1 INSULATION.

READ THE FOLLOWING:

NEWTON ELECTRIC LIGHT AND POWER CO.
NEWTON, MASS., Sept 20, 1888

MR. A. F. MASON, Gen. Manager, the Simplex Electric Co.,
Boston, Mass.

Dear Sir:—We have in use sixty three miles of your Wire No. 1 insulation, nine tenths of which is through solid rows of trees. Your insulation wears smooth and glossy without cutting through where it chafes against small limbs. I consider it better for tree work than any other in the market at any price. Yours respectfully, H. H. CUTLER,
(Signed) Superintendent.

Some months since I determined to give the "SIMPLEX WIRE" a severe test. I made a test for leakage by keeping a couple of lengths immersed in water for twenty-two days, and at the end of that time I could get no evidence of leak through the insulation. I then made some sharp bends in the wire, but could not find that this opened the covering in the least. I suspended a sample vertically in a hot boiler room, to test the running qualities; for some samples of another wire which I had been strongly recommended to use were surrounded with an insulation which would —did—cook out, and I had no desire for further experience in that line. Your wire stood the test nobly.

While I am recommending your wire for out-of-door work, through damp cellars, laundry washrooms, kitchens, and other moist places, and expect to see it put, in the course of the season, into a brewery where ammonia is used for manufacturing ice, understand I am only too glad to accept it for all ordinary inside work where "Underwriters" has up to date had its best hold. I am, sir, yours respectfully,
(Signed) C. C. HASKINS, Electric Light Inspector.

THE SIMPLEX ELECTRICAL COMPANY,

A. F. MASON, General Manager,

328 WASHINGTON ST., - BOSTON.

THE "U. S." INCANDESCENT LAMPS.

TO THE PUBLIC:

The statements of the Edison Co., to the effect that the Supreme Court decision in the "Bate Refrigerator Case," settles their claim to the absolute right to manufacture and sell incandescent lamps, is misleading and untruthful. The only possible bearing it can have on the lamp question is to let the Edison patents live a little longer, or until the merits of the case can have a hearing.

The U. S. Lamp Patents are absolutely fundamental.

The Best is Always the Cheapest.

The United States Electric Lighting Co.,

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MANUFACTURERS OF ALL KINDS OF

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FOR ELECTRIC TRANSMISSION OF POWER.

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Materials and Workmanship are Guaranteed the Very Best,

and correspondence is solicited from companies and architects requiring our articles.

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Speed,
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The Daft Motors for Power Distribution are unexcelled.

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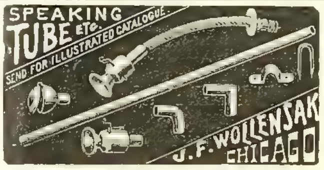

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Arc and Incandescent light a specialty. Existing plants extended or thoroughly overhauled.

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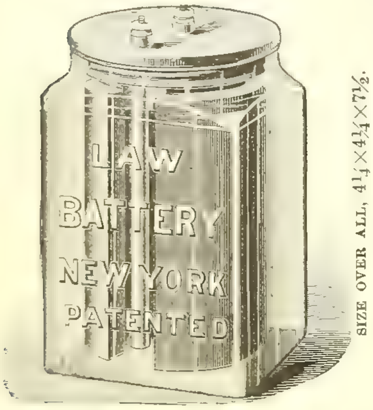
FOR ALL CLASSES OF OPEN CIRCUIT WORK.

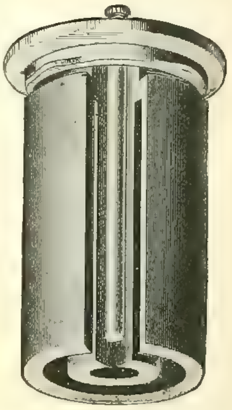


SIZE OVER ALL, 4¼×4¼×7½.

In the latest form the negative element is a ***Double Cylinder, one within the other,*** having more surface and quantity than any other negative element in the market. Its efficiency and durability surpass all its rivals, and ***it is guaranteed for ten years.*** As now made both elements are secured wholly beneath the cover, instead of passing through the cover, as heretofore. The cover is of blue glass and locks tight to the jar, absolutely preventing evaporation of water and creeping of salts. Both binding posts are permanently attached to cover, and thoroughly protected against corrosion.

THESE ARE DECIDED IMPROVEMENTS.

Do not be so foolish as to buy a Prism, Porous Cup, or other perishable negative element battery, when one can be had which is ***PRACTICALLY EVERLASTING.*** And do not waste money by experimenting with any of the numerous new and untried batteries which are constantly coming and going, but buy the "Law," which ***has stood the test of eight years.***



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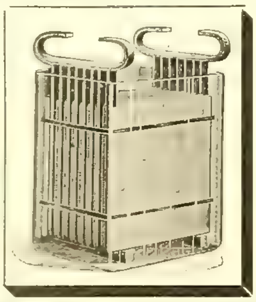
Electrical Accumulators or Storage Batteries,

Especially Adapted to

STREET CAR PROPULSION.

THE ONLY SYSTEM Which Completely Displaces Gas.



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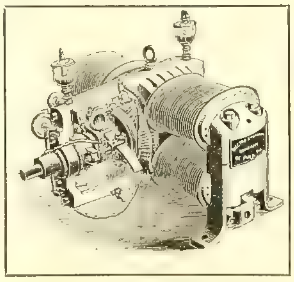
EDCO SYSTEM.



DYNAMOS, MOTORS,
Batteries, Voltmeters and Ammeters,
SWITCHES,
And Complete Electric LIGHT and POWER PLANTS
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A Full Line of their Celebrated Wires, Cables and Tapes in Stock, at Factory Prices.

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54 and 56 Franklin Street - - - CHICAGO.

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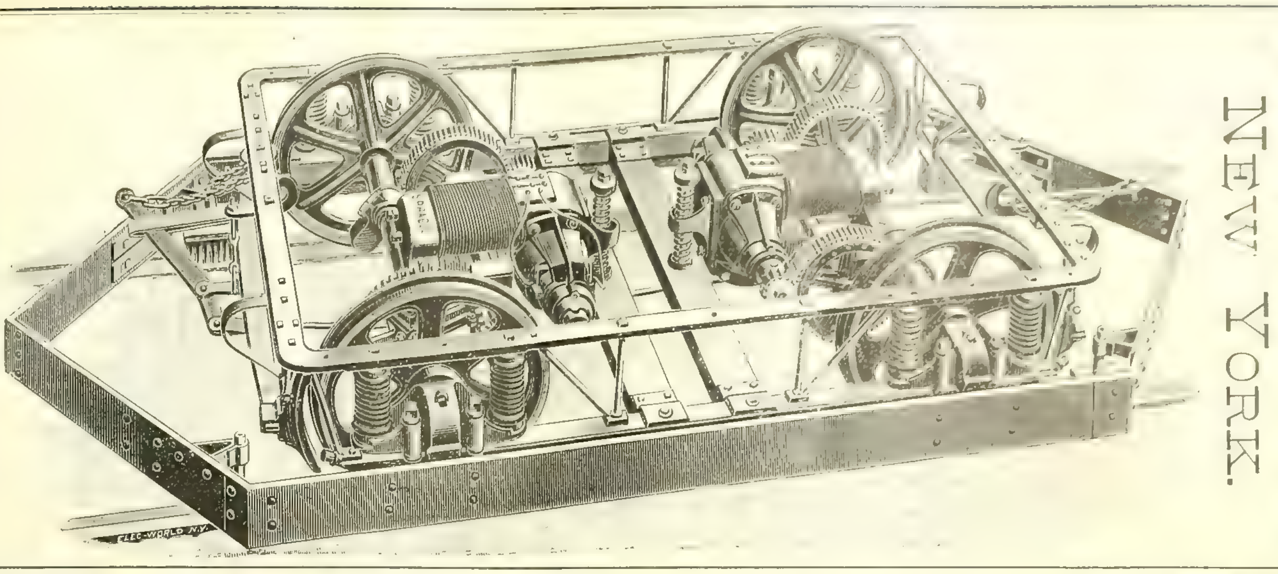

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Installation of Complete Electric and Steam Plants for Arc and Incandescent Electric Lights, Electric Transmission of Power, Electric Railways, Electric Equipments for Hotels and Residences.

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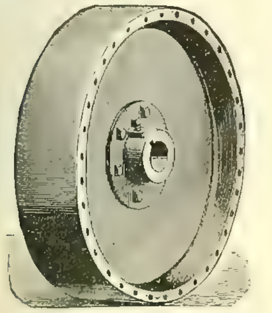

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If you would SECURE the BEST RESULTS,

Use PAPER PULLEYS.

The following is the result of a test recently made at the Franklin Institute, showing the relative value of Paper Pulleys over Iron in the transmission of power:
Transmission, Iron, 24 lbs.; Paper, 144 lbs., with equal tension of belt.
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Width, Iron, 12 inch; Paper, 3 inch (unsafe for belt).
Diameter, Iron, 48 inch; Paper, 24 inch for equal tension.
Contact, 90° on 24″ Paper equals 180° on 36″ Iron.

☞ These Pulleys are used and indorsed by the leading Electric Light Manufacturing Companies.

For Price Lists and discounts write to

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Ball Electric Light Co.

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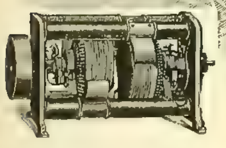

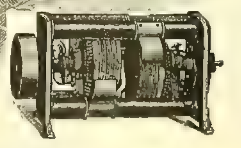

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FOR ARC AND INCANDESCENT LIGHTING.

This system is ***mechanically*** and ***electrically*** perfect, and produces a steady white and noiseless light with the minimum of expense, both as to the power required and the cost of repairs.

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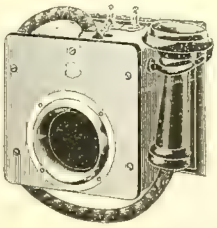

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BENNETT TELEPHONES,

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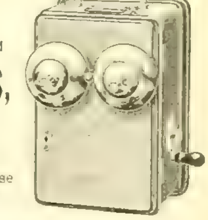

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Especially Adapted to Covered or Heavy Galvanized Steel Wire.

MECHANICAL, ELECTRIC, OR MAGNETO SIGNALS.

Our U. S. Patents—15 in number—broadly cover, either combined or separately, the use of a Hearing Tube, a Curved Transmitter Tube, perfect Insulating Devices and numerous minor features, likewise a transmitting wire covered or muffled, or formed of *two or more strands of wire twisted or braided together.* The use of any of these features with any other mechanical telephone infringes our rights, and renders the manufacturer, seller or user liable to suit therefor.

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UNIFORM IN QUALITY, LONG LIFE AND GOOD LIGHT.

COMPLETE POWER PLANTS

A Specialty, comprising

IDEAL or ECLIPSE CORLISS ENGINES,

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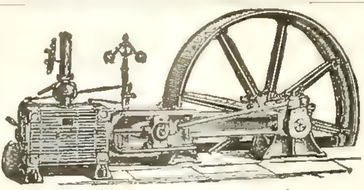
IMPROVED CORLISS ENGINE

Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

IT IS UNEQUALED FOR ECONOMY OF FUEL, REGULARITY OF MOTION, AND DURABILITY IN USE.



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Manufacturers of and Dealers in

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Storage Battery for Light and Stationary Power.

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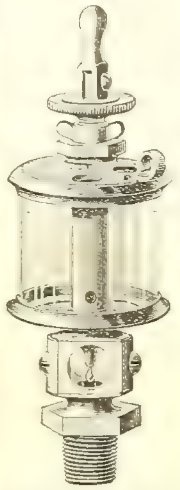
Electric Traction by Storage Batteries.

OFFICES: 120 Broadway, New York.

Sight Feed Glasses easily replaced by common window glass, if broken

Fig. 1.



Shows Oil dropping while Machinery Runs.

Powell's Improved "SIGNAL"

DYNAMO OILERS.

Sight chamber is fitted with square window panes, which are secured by brass end plates, and can be removed for inspection, cleaning or repairs, at any time, without stopping the oil feed, while the machine is running.

THE VERY BEST

DYNAMO OIL CUP

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The Wm. Powell Co.,

50, 52 and 54 PLUM STREET,

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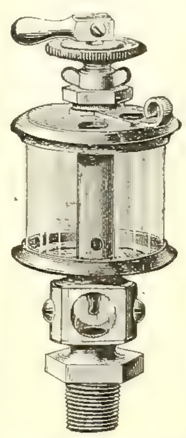
Fig. 2.



Shows flow of oil stopped when Machinery stods.

Flow of oil can be instantly stopped or started without changing degree of feed

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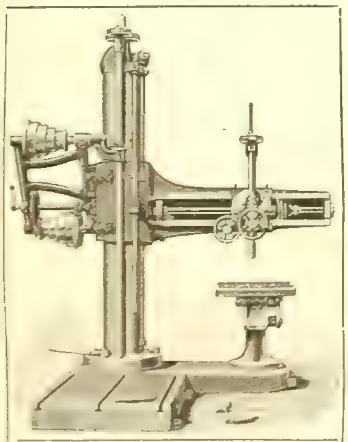

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Complete Equipment for the Manufacture of Electrical Machinery,

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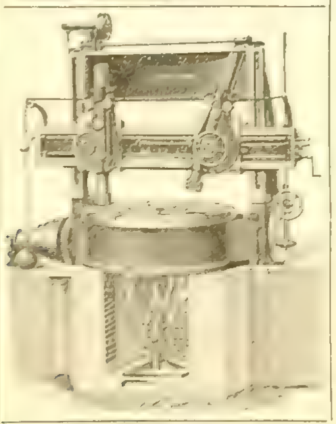

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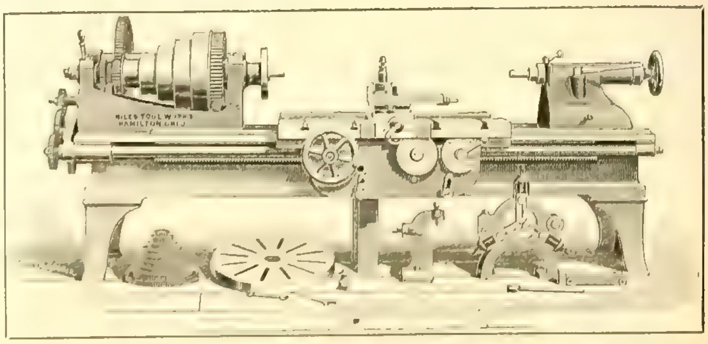

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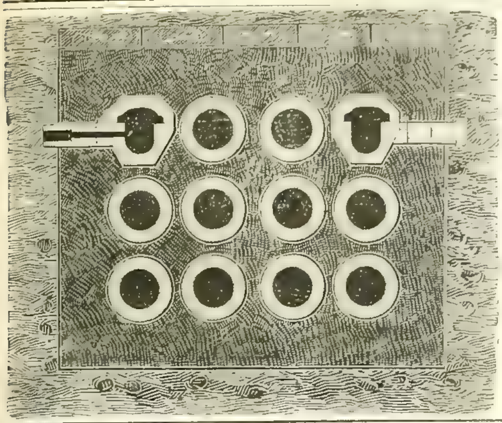

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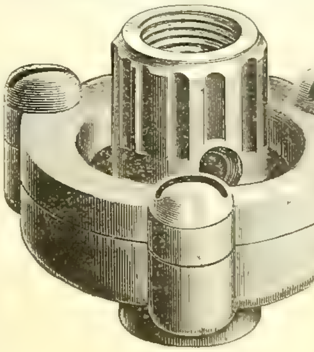

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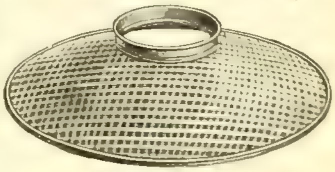

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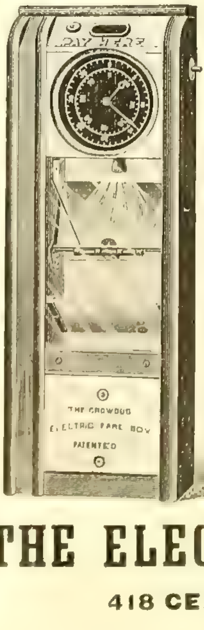

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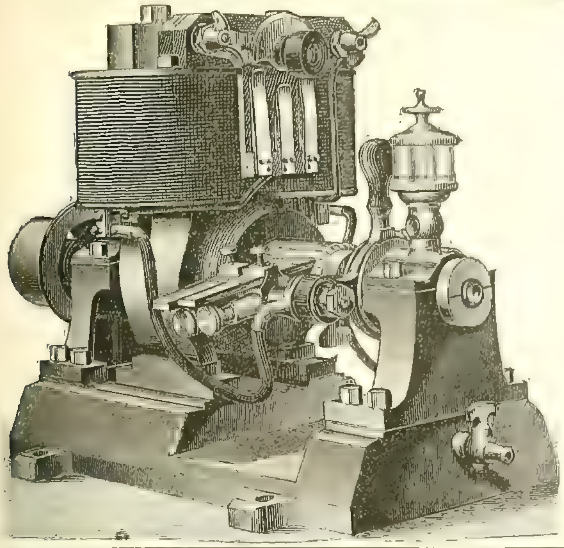

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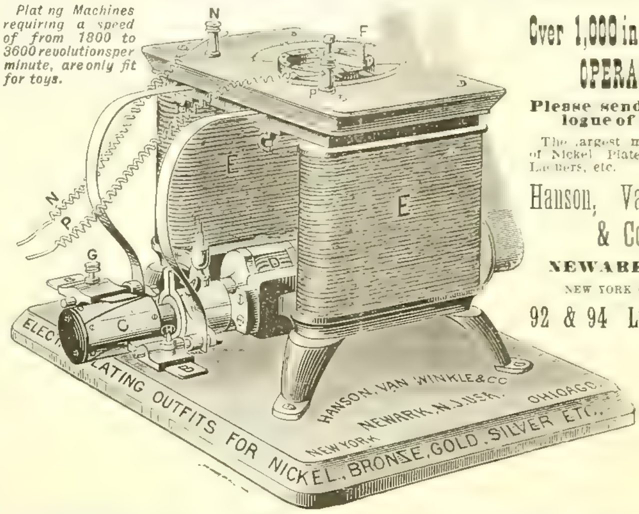

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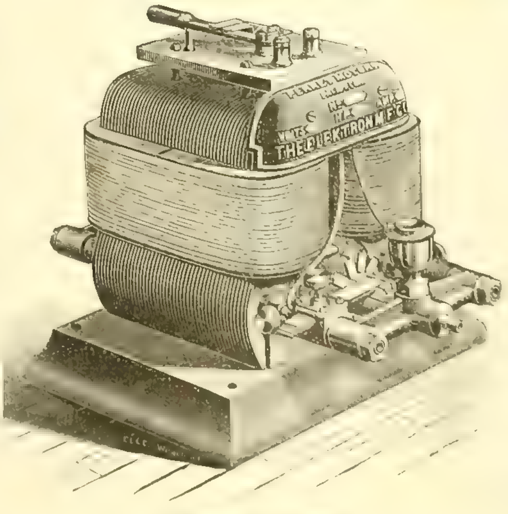

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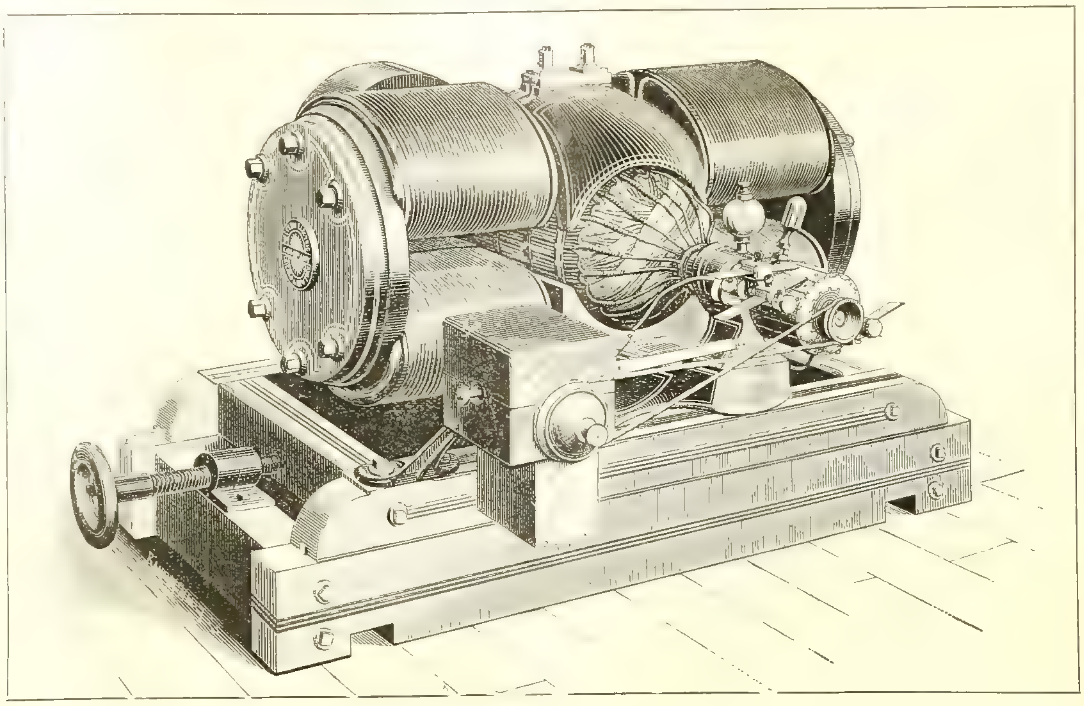

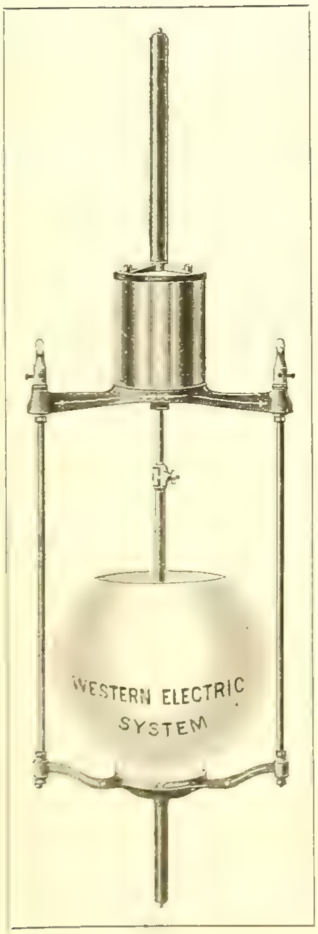

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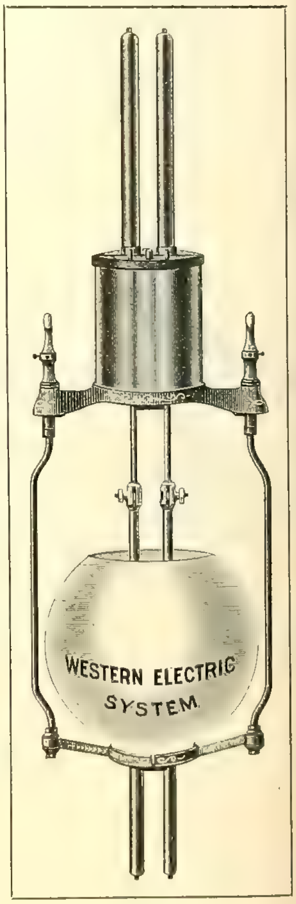

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Western Electrician

EVERY SATURDAY.

Vol. IV. CHICAGO, MARCH 2, 1889. No. 9

Edwin Ruthven Weeks.

An admirable portrait of Edwin Ruthven Weeks of Kansas City, Mo., who was elected president of the National Electric Light association at the Chicago convention, is herewith presented. Mr. Weeks is one of the most enthusiastic members of the organization. His confidence in the future development of electricity is best illustrated by the fact that he has every dollar of his capital invested in electric light interests. He was one of the organizers of the association, and has taken a prominent part in its deliberations and discussions. At the first meeting of the organization four years ago he was chosen second vice president, and was continued in that office the following year. During the last two years he has been first vice-president. At the end of the first year of the association an effort was made to secure Mr. Weeks' consent to accept the position of president, but he refused to consider the proposition, holding that the office should be filled by an eastern man, a resident of one of the large eastern cities, within easy reach of the large electric light concerns. At the earnest solicitation of prominent members of the association, Mr. Weeks agreed to allow his name to be presented to the last convention, hoping that his election might serve to develop the interests of the organization in the west.

In conversation with a representative of the WESTERN ELECTRICIAN, after his election, President Weeks said: "There are not more than a dozen companies west of the Mississippi holding membership in the association, although there are many companies deeply interested in the proceedings. I shall endeavor to bring these companies into the organization, and make it what it is intended to be—a National Electric Light association."

President Weeks is a man of great executive ability. He is a self-made man, and possesses a practical as well as theoretical knowledge of the electric light business. The new executive was born in Chautauqua county, New York, thirty-three years ago. He was educated at the Phillips Exeter academy, Exeter, N. H., and Tabor college, Fremont county, Iowa. He refers with pride to the fact that he paid for his own education. When still young he entered the newspaper business in Kansas City, occupying positions in the mechanical and circulating departments of the Kansas City *Journal*. He afterward occupied a position in the postoffice of Kansas City, and when obliged by failing health to retire from that office, accepted a position as conductor on the east division of the Union Pacific railroad between Kansas City and Denver. In 1882 President Weeks became interested in the electric light business. He was appointed first superintendent of the Kansas City Electric Light company. Later, the office of manager was created, and he was appointed to that position. Two years ago the office of general manager was created, and President Weeks was raised to that position. He now occupies similar offices in the Edison Electric Light & Power company and the Sperry Associate Electric company of Kansas City.

His election met with the unanimous approval of the association. The members of the organization are congratulating themselves upon securing the services of such an able and enthusiastic gentleman for the position. There is every reason to believe that his election will greatly strengthen the association in the west.

EDWIN RUTHVEN WEEKS.

Victory for the Bell Company.

Benton J. Hall, commissioner of patents, last Saturday rendered an important decision in the matter of the petitions of Gray and McDonough to reopen the Bell Telephone interferences, and to set aside the decision of Commissioner Butterworth, rendered March 3, 1885, awarding priorty of invention to Bell. The decision reviews the whole department history of the telephone contests. The commissioner refuses to reopen the interferences, and reaffirms the award of priority to Bell.

The history of the case, briefly stated, is as follows: The parties who were originally involved were Bell, McDonough, Edison, Richmond, Gray, Dolbear, Holcombe, Chinnock, Randall, Blake, Irwin, Phelps and Voelker. When these several inventors entered upon the field of invention, with respect to the transmission of speech, all the elements of the telephone were old and well known. None of the elements could be broadly claimed, but only the specific construction into which they entered. On March 20, 1878, various interferences were declared.

The taking of evidence was concluded and filed before the examiner of interferences in May, 1881, and the cases were argued before him in October and November, 1881. On July 21, 1883, he entered his [illegible] priority to Bell in cases A, B, C, E, F, H, I and J; priority to Edison in cases D and K, [illegible] priority to McDonough in case G. Appeal was taken to the examiners-in-chief, who on October 3, 1884, affirmed the decision of the examiner of interferences as to all the issues except G, in which they reversed him and awarded priority to Bell. McDonough and Gray appealed as to issue G. March 3, 1885, Commissioner Butterworth affirmed the decision of the examiners-in-chief.

March 20, 1887, Commissioner Montgomery rendered a decision holding that, as to the first petition of McDonough, it was concluded by the decision of Commissioner Butterworth, of January 16, 1885. As to the second, he held that Mr. McDonough had the right to be heard. McDonough's case and Gray's proposed amendment were finally set down for disposition on February 1st, 1888, on which day the parties appeared.

As to Gray's petition to reopen the case, Commissioner Hall, in his decision, held substantially as follows: That this petition "is of no avail for any purpose whatever; that Gray proposes no new evidence as to dates, nature or the character of his own invention; that it was conclusively shown in the evidence that Gray, at the time of filing his caveat, while having a conception of the telephone, did not understand the invention, and was unable to explain the mode of its operation; that he still adhered to the idea that articulate speech must be transmitted upon the multiple telegraph principle; that he positively conceded that he did not reduce his invention to practice for a long time after the issuance of Bell's; that he regarded the invention as trivial, and turned his attention to other inventions; that he negligently omitted to file his application for a patent until two years after the grant of Bell's patent, and was then stimulated to do so only by other parties; and that he cannot prevail against another and independent inventor who was diligent and has fully reduced to practice."

On October 29, 1887, Gray was induced by his assignees, who agreed to pay all expenses, to file his applications Nos. 1, 2 and 3, after the commercial value of Bell's invention was beginning to be acknowledged.

Infringement suits followed between the Bell company and the American Speaking Telephone company and Western Union Telegraph company (the latter controlling the inventions above mentioned) in the United States Circuit court for the District of Massachusetts; in which suits the court sustained the Bell patent. But valuable improvements had been made in the speaking telephone, and the Western Union Telegraph company and associates, with [illegible], proceeded upon the basis of these improvements and opened negotiations with the Bell company to compromise the litigation and unite all patents relating to the speaking telephone [illegible]

to be agreed upon. This agreement was finally [illegible] November 1, 1879, holding for seventeen years.

In pursuance to this contract a decree was entered on April 4, 1881, adjudging Bell's patent to be valid, and perpetually enjoining the infringement of the same. The effect of the agreement was to invest the Bell company with the ownership of all the telephone inventions, which at that time were supposed and believed to include Gray's inventions. The evidence taken in these [illegible] was by stipulation transferred and introduced in the interference cases pending in this office.

Relative to the assertions in Gray's petition, attacking the procedure in the Patent office, that Bell had fraudulently secured access to his caveat; alleging collusion on the part of Bell's assignees; that Gray was misled by improper advice of his counsel in admissions and concessions of priority to Bell, and in neglecting to take an appeal from the decision of the examiner of interferences, in certain issues, etc., etc., the commissioner finds each and every allegation to be unsupported by the evidence in the office and the records made up in the various cases decided by the Circuit and Supreme courts. The commissioner therefore denies the petition of Gray to reopen the interference and to grant a new trial.

The commissioner does not dispose of McDonough's petition by holding that he cannot amend, but says that the situation is suggestive, as a patent now issued to McDonough, after a contest with Bell, would dominate the entire telephone inventions, and it is a serious question whether an applicant who has voluntarily canceled his claims and apparently abandoned them should be permitted, after the invention has been publicly introduced and made commercially valuable, to return after eleven years and amend, and claim an interference with a patent so long [illegible]

[illegible] McDonough are denied, the [illegible] ing deemed insufficient to justify the commis- [illegible] r Butter- [illegible] Bell.

[illegible]

Ganz & Co.'s Continuous Current System.

Ganz & Co.'s alternating transformer system, or, as it is generally called, the Zipernowski-Deri system, was illustrated in the WESTERN ELECTRICIAN of January 19th. In the present article the two-pole continuous current dynamo with drum armature, which the firm has been manufacturing for two years, is described. As this dynamo differs from other generators which it resembles in its outlines, a description is of interest. Fig. 1 shows a dynamo of a capacity of 6,000 watts; it can be run either at 110 or 60 volts electromotive force. It is provided with a pulley so that it may be connected in the usual way by means of a belt to a driving pulley.

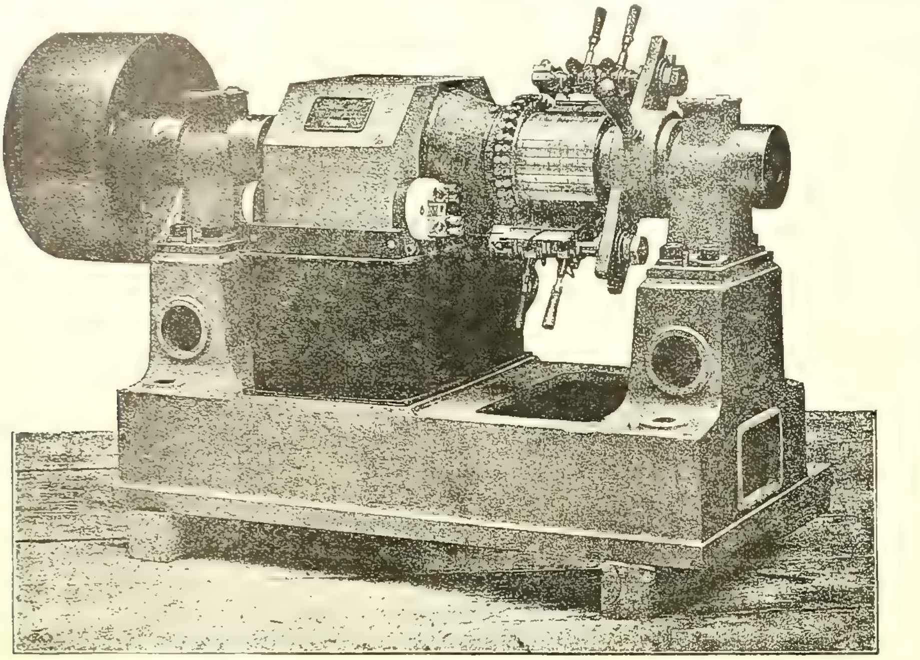


FIG. 1. GANZ & CO.'S CONTINUOUS CURRENT SYSTEM.

Fig. 2 represents a larger dynamo coupled directly to a high speed steam engine; this dynamo yields, at 375 revolutions, 110 volts and 400 amperes. The electro magnets of the Delta dynamo, as Ganz & Co. call this type, consist of [illegible] wrought iron [illegible] cast into the bedplate of the dynamo. A very low magnetic resistance [illegible], which is still decreased by the fact that the grain of the wrought [illegible] direction of the lines of force.

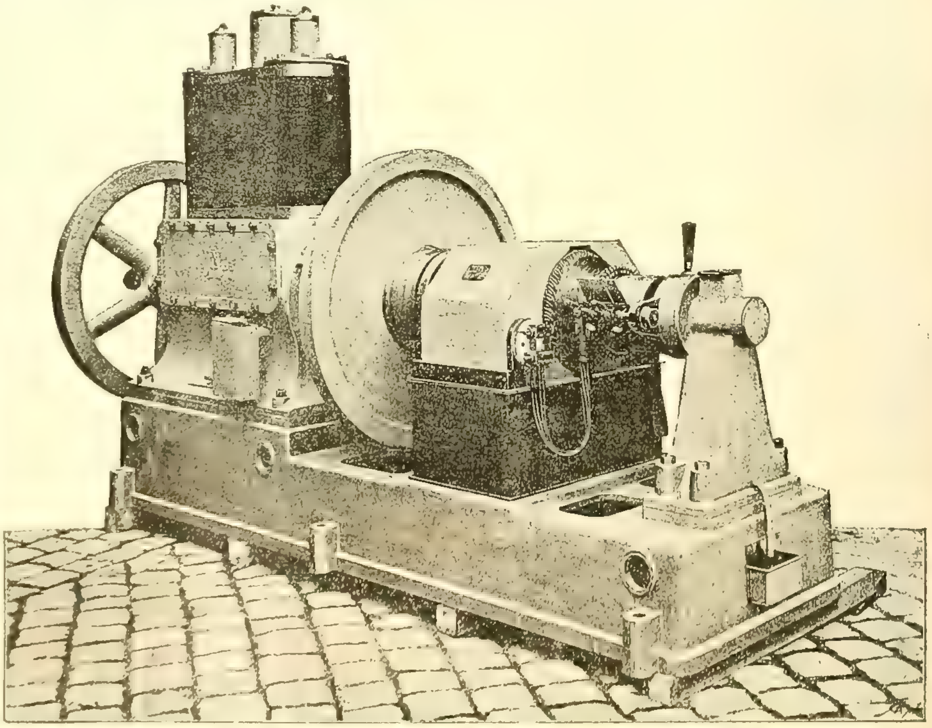


FIG. 2. GANZ & CO.'S CONTINUOUS CURRENT SYSTEM.

The [illegible] first shown at the National exhibition at Budapest in 1885, consists of iron disks half a millimeter thick, separated by thin layers of paper. The cylindrical surface represented by the edges of these disks is grooved, the grooves being narrow and deep. The coils of wire with which the armature core is wound are placed in these grooves.

The clearance between the armature and pole pieces varies in the different sizes of dynamos from 2 to 3.75 millimeters. The magnetic resistance of this air gap is consequently very small; notwithstanding this fact there is very little leakage at the pole pieces, as the vibration of the lines of force produced by the narrow teeth and hence the eddy currents set up in the pole pieces cause only a very small loss of energy.

Fig. 3 shows the iron core of the drum armature and the shaft without the wire coils. Fig. 4 shows the complete armature with commutator. The unusally large commutator affords a good and easily regulated contact and the result is longevity of the generator. The connections of the wires leading from the armature to the commutator are made in the following way: Each commutator segment is provided with a hole into which the wire is inserted; it is fastened by means of two set screws. The set screws are prevented from working loose by a very simple but effective device. The heads of the set screws are provided with holes. A short piece of wire is passed through the holes of the same segment and then the ends of the wires are turned over. Thus practically the two set screws are coupled together and one prevents the other from turning.

The number of brushes for the different sizes of dynamos varies from one to three sets. The pressure which each brush exerts while resting on the commutator may be regulated by means of a small thumb screw; at the same time the whole brush holder with all the brushes may be shifted by a large hand lever.

The bearings of the small dynamo are made of bronze while those of the larger dynamos are made of cast iron and provided with bronze journals. The iron bearings are, however, magnetically insulated from the bedplate by a zinc frame in order to prevent a leakage of the lines of force through the bedplate, bearing and shaft. The bolts holding these bearings down to the bedplate are of brass.

The ends of the armature are covered with strong canvas to keep out copper dust, oil and dirt. For the same reason the field magnet coils are covered with oilcloth.

The main binding posts of the dynamo, which at the same time serve the purpose of holding the main safety plugs, are mounted on porcelain and are attached to the field magnets. The lead binding posts are also mounted on porce-

lain and are attached to the field magnets opposite the main binding posts.

A strong perforated zinc plate extending from one pole piece to the other protects the armature against accidents caused by tools or dirt dropping from above.

The dynamos are well finished and handsome, as all bright parts are nickel-plated with the ex-

Cornell Electric Students' Annual Inspection.

The [illegible] for the [illegible] tour of the electric classes of the Cornell university, [illegible], N. Y., has been arranged. [illegible] party [illegible] western trip, [illegible] ter, [illegible], Niagara Falls, B[illegible], [illegible] Allegheny and Cleveland, while the [illegible]

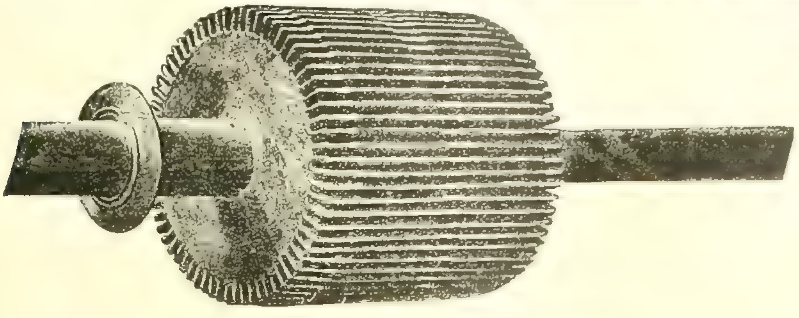


FIG. 3. GANZ & CO.'S CONTIN[illegible] CURRENT SYSTEM.

ception of the commutator. The dynamo, if it is to be connected by means of belting, is set on a sliding base frame with belt tightener, which is set on a suitable foundation. If the dynamo is to be coupled directly to a steam engine the magnet cores are cast into one iron bedplate and the steam engine is magnetically insulated from this bedplate by a zinc frame. The Delta dynamos, either shunt or compound, are used for direct lighting or for exciting alternating current dynamos; they are made either for 110 or 60 volts. They are also made for very much higher electromotive force, for transmission of power, and series arc lamp systems, or with

will visit Yonkers, New York, Jersey City, Marion, Brooklyn, Orange, Newark. Among the points of special interest which the party will visit are the following: Cowles' Electric Smelting works, Westinghouse Electric company, Standard Underground Cable company, Faraday Carbon company, Brush Electric company, Standard Carbon company, Natural Carbon company, Eichemeyer Dynamo works, Edison's (N. Y.) station, Bergman & Company, Julian railway, New York city, Daft Electric works, Excelsior Electric works, Gibson Storage Battery works, Metropolitan Telephone exchange, Edison's laboratory, United States company's Newark factory, Hewes & Phillips' engine works, Weston's laboratory, Daft power station for New York elevated electric railway, Western Electric company's New York house. In addition to these prominent electric concerns the tourists will inspect numerous electric light plants and power stations, both public and private, and will have an excellent opportunity to investigate the practical workings of those plants.

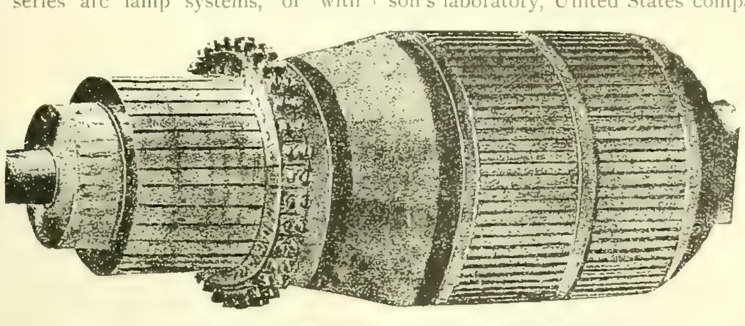


FIG. 4. GANZ & CO.'S CONTINUOUS CURRENT SYSTEM.

much lower electromotive force for electro-plating and other electro-metallurgical purposes.

The regulation of the shunt dynamo is effected either by hand rheostats or by automatic regulators.

The appended table contains dimensions, weights and other particulars. These data were not calculated to represent the actual measurements:

No.	Delta Dynamo.	1		2		[illegible]		[illegible]		5	
1	Maximum load .... in watts	[illegible]	1,650	3,600	[illegible]	[illegible]	6,600	[illegible]	11,[illegible]	[illegible]	[illegible]
2	Maximum current strength ... in amperes	[illegible]	[illegible]	[illegible]	[illegible]	120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Difference of potential at terminals .. in volts	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Revolutions per minute	1,400		[illegible]		[illegible]		600		500	[illegible]
5	Length of bedplate ..... in mm	680		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
6	Breadth of bedplate ..... " "	[illegible]		435		[illegible]		[illegible]		[illegible]	[illegible]
7	Height of dynamo .... " "	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
8	Diameter of pulley .... " "	100		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
9	Face of pulley .... " "	100		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
10	Diameter of commutator ..... " "	110		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
11	Length of commutator ..... " "	80		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
12	Number of sets of brushes	[illegible]		1		[illegible]		[illegible]		[illegible]	[illegible]
13	Total weight of dynamo .... in kilogramms	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	[illegible]
14	Electrical efficiency .... per cent	90.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	Commercial efficiency ..... " "	80.5	79.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	No. of 16 c. p. incandescent lamps of [illegible] watts	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	" " " " " " 53 "	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	Width of grooves in armature core in millimeters	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.0	[illegible]	[illegible]	[illegible]
19	Depth " " " " "	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16.0	[illegible]	[illegible]	[illegible]
20	Loss of energy in the armature wires ... in watts	47	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	Intensity of the magnetic field .. in C. G. S.	[illegible]	13,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	14,[illegible]	[illegible]	[illegible]	[illegible]
22	Loss of energy in field magnet coils .. in watts	151	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	Total weight of copper wire on the dynamo in kilogrammes	[illegible]	11.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	Output per kilogramme of the total weight .... in watts	7[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	Output per kilogramme of the total weight of copper .... in watts	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	Output per kilogramme of the total weight of armature .... in watts	[illegible]	[illegible]	[illegible]	580	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	Output in watts per horse power at the pulley	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28	No. of incandescent lamps of [illegible] watts per horse power with 5 per cent. loss in leads	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7	[illegible]	[illegible]	[illegible]	[illegible]
29	No. of incandescent lamps of 53 watts per horse power with 5 per cent. loss in leads	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
30	Horse power required with full No. of lamps and 5 per cent. loss in leads	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.0	[illegible]	[illegible]

Notes to the above table:

To No. (1) With either 60 or 110 volts difference of potential at the terminals.

To No. (16 and 17) Calculated from the maximum amperes for lamps of 56 or 100 volts.

To No. (20) Under full load for several hours.

To No. [illegible] With either [illegible] volts difference [illegible] terminals.

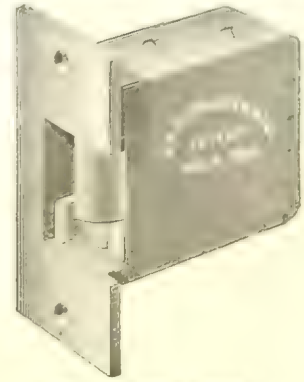
To No. [illegible] load for several hours.

To No. [illegible] 7) With maximum ampere [illegible] difference [illegible]

To No. [illegible] Lamps for either [illegible] volts.

Ostrander Door Opener.

[illegible] market by W. [illegible] and jars successfu[illegible]



[illegible]

[illegible] springs, as it is a [illegible], protected by metal sides to prevent dirt, plaster and chips from interfering with its operation. The movable bolt is a steel drop forging, and the other parts are of the best wrought iron and steel.

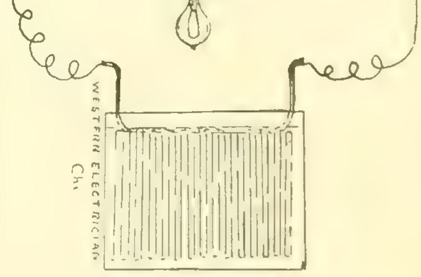
Novel Transformer.

"Did you ever see a 50 volt lamp run from a 2 volt cell?" asked F. B. Badt of a representative of the WESTERN ELECTRICIAN who called upon him the other day at the factory of the Western Electric company.

The question had to be repeated before the professor convinced the writer that he had not misunderstood him.

"Well, I'll show you one," said Mr. Badt. "It's a little machine of my own which I have been experimenting with, but have not yet completed. This is my first experiment. As soon as I get time I shall construct a new machine which will embody many improvements on this."

The device to which the professor referred was a very simple apparatus, consisting of one storage cell, one transformer and circuit interrupter, and one 50 volt incandescent lamp. The



NOVEL TRANSFORMER.

principle of this apparatus is represented in the cut, which will give a fair idea of the principle, but of course does not illustrate the real working of the apparatus. As soon as the switch of the primary circuit was closed the interrupter commenced to work, and the 50 volt lamp [illegible] to full candle power. While this arrangement may not be, from an economical standpoint, suitable for general use, yet many circumstances might be suggested in which the apparatus would be desirable. It is at any rate an interesting experiment, and it is only to be regretted that the details of construction cannot be presented.

Detroit Batteries for Street Car Propulsion.

The possibilities of the storage battery have not yet been [illegible]. At present the great problem seems to be the utilization of these batteries for street car propulsion. It has been demonstrated that a street car can be operated by means of storage batteries, and it has further been learned that, aside from the first cost of installing an electric plant, the expense of operating a road is comparatively small. But the manufacturers of storage batteries are far from satisfied with the experiments thus far made, and of late many important improvements have been made in the system, which has been adopted in many cities. Prominent among those who have been experimenting in this line is the Woodward Electrical company of Detroit, Mich. Frank B. Trout, general manager of this company, announces that great progress has been made, and refers to the fact that electric cars are now operated in Brooklyn and Detroit by means of Detroit storage batteries. The experiments made in these cities justifies him, he thinks, in announcing that the Detroit storage battery is capable of operating street cars successfully, and with the improvements recently made in the system in connection with which it is used he believes the problem of rapid transit has been solved.

The new car of the Friction Electric company, operated in South Brooklyn by means of Detroit storage batteries, is illustrated herewith. A. A. Ingraham, the inventor of the system, says the man in control of the car need have no knowledge of electricity, and that all that will be required of him will be to perform the regular duties of an ordinary car driver. The car is carried by a specially constructed framework, in which, instead of the ordinary two axles, are mounted three axles, two of which are movable with regard to the framework carrying them. These two pairs of wheels are controlled by an ordinary brake lever at the front of the car, and the box in which the axles of these wheels are mounted has a limited movement with regard to the framework. Their movement is controlled by a double bell-crank lever operated by the brake lever, and by which the pressure between the friction wheel and the car wheels can be increased or diminished at will. At present wrought iron against cast iron is used as a friction surface, but the intention is to make cast iron and cast iron operate against each other. The two front wheels of the car frame have on their surfaces annular cast iron rings against which the friction wheel works. Between these movable wheels is mounted a friction wheel carried by a counter-shaft run by the motor. On this counter-shaft is a gear wheel having wooden teeth mounted in a cast iron frame and meshing with a brass pinion mounted on the shaft of the motor. The car carries 84 Detroit storage battery cells, and is calculated to run 60 [illegible] of 7½ h. p. The motor and its frame are entirely independent of the framework of the car. The motor is controlled from either end of the car by two separate and distinct mechanisms, one of which is a cylindrical [illegible] the speed of the motor [illegible] make-and-break [illegible] the brake that stops [illegible] switch has five contact [illegible] speed is given to the [illegible] sufficient to [illegible] switch off the [illegible] out of circuit [illegible] the armature. In addition to the ordinary method of controlling [illegible]

Practical Telephony.

By Thos. D. Lockwood.

PART XVI.

It is usual to speak of the telephone exchange and the central office as though these were equivalent and interchangeable terms. They are not, however. The exchange, properly so called, comprehends the central station, and the collection of subscribers' stations, together with the entire system of wires and apparatus uniting the former with the latter, and by means of which communication is had. The central office, or, better, the central station, on the other hand, is the place where the work of putting any two lines together is actually performed, and, as I have shown, is only a part of the telephone exchange.

Nevertheless, as most of my remarks so far have been directed to lines and apparatus, and their care, without regard to whether they have formed parts of an exchange or have been on their own hook, I propose, before saying the few words I may have to say about the central station proper, to refer briefly to the telephone exchange in its broadest sense.

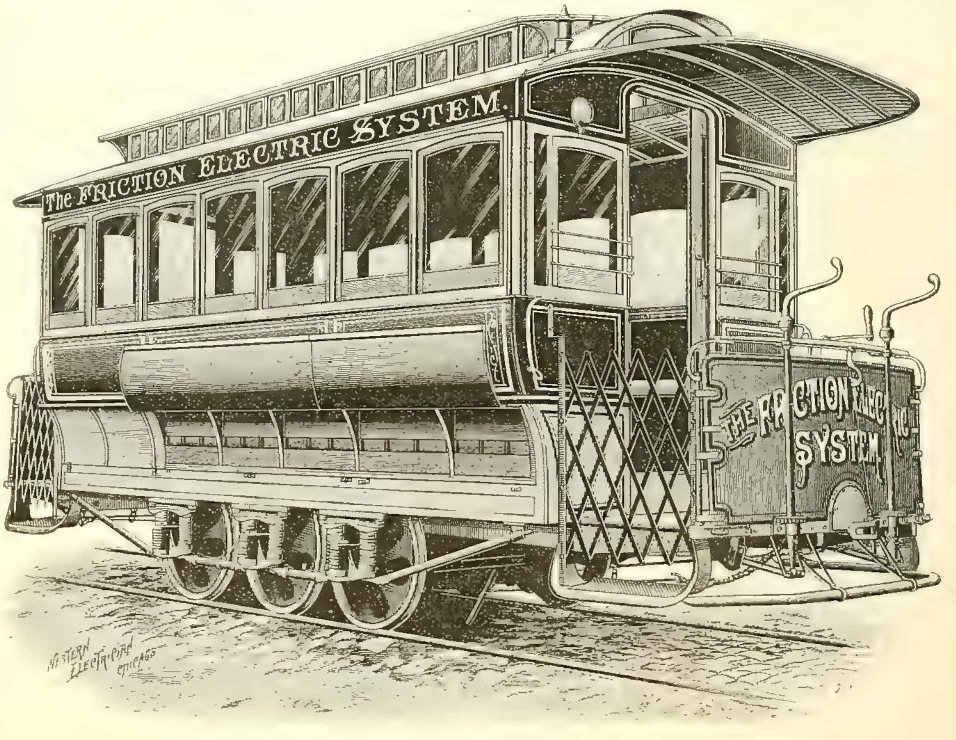
We can easily conceive that telephonic communication between two places only—a private line, for instance—would be but a moderate benefit; and it became appreciated at an early date by those interested in telephony that the great field of the speaking telephone was not merely for communication, but for intercommunication.

We know that an electric current only requires a wire to conduct it, and that, if we have two lines terminating in the same room, we have only to hitch the ends together to make a single line connecting the two out stations. So, if we have ten, a hundred or a thousand lines, all centering at the same place, we can ring the changes upon them all, and unite the ends of any one with either of the nine or ninety-nine whenever we wish to do so. This is the work of the telephone exchange. And this, it is, that the subscriber to the exchange pays for; not for the prime privilege of having a telephone apparatus hanging up in his parlor or counting-house, but for the ability and privilege of using the said apparatus to talk without leaving his own abode with the entire nine, ninety-nine or nine thousand nine hundred and ninety-nine, as the case may be, and it is, therefore, natural that he has to pay more for the ability of being connected [illegible] the former.

[illegible] system may, I think, be [illegible] a wheel without a [illegible] central station forming the hub, and the [illegible] the spokes.

This idea is illustrated in Fig. 29, in which a series of spokes, numbers 1 to 7, are shown as converging to a central hub or axle C. As this is a *tireless* wheel, the only way in which one spoke can be united with any other is by means of the hub, and it is the duty of the operator there to make this union whenever required, and in this way the diagram shows the lines 1 and 7 to be so united by a curled wire, *w*. The importance of this idea was realized even in the earliest days of telephonic transmission, and by May, 1877, was experimentally dealt with at the office of E. T. Holmes, 342 Washington street, Boston, where a number of lines constituting a system of electric burglar alarms already in use converged. Fig. 30 represents diagramatically the very crude switch-board employed in the above trial, and Fig. 31 shows the circuit arrangement.

This switch-board comprised simply a series of plates of brass, *a*, fastened to the face of a black walnut board, B, and stretching across one-half of its width or thereabout; opposite the ends of each of these plates were two others, *b* and *c*; these were much narrower than the upper plates. All of the plates were provided with a single binding screw; and in each a plug hole was drilled. Besides this a similar hole was drilled



DETROIT STORAGE BATTERIES FOR STREET CAR PROPULSION.

between the ends of each broad plate and its two narrow ones, so that a metal plug could be inserted either in any plate or between each broad plate and either of its narrow ones, uniting them. The board was about an inch thick, ten inches wide, and three feet long, and a portion at one end was left unfitted with the brass plates, as shown; when operated it was screwed up against a wall.

In the diagram Fig. 31 the switch-board proper is in all respects the same as before, but the circuits also are indicated. The several broad plates, *a*, are each connected with a line wire leading to some distant office or station, six being shown. The narrow plates, *b*, were all connected by wires, *g*, with the burglar alarm galvanometers and bell alarms so that calls could be received from and sent to the several outstations. The narrow plates, *c*, were all united by wires with one another and with a telephone, t^2, in an earth branch, G. At each sub-station the lines terminated in a switch, *s*, which could be turned on a bell alarm, *e*, to receive calls, or on a telephone, *t*, for conversation. A push button or call key (not shown) was also used for sending signals.

The lines 2, 4 and 6 are shown as being at rest, a connecting plug being inserted in the hole at each plate, uniting their plates, *a*, with the galvanometer plates, *b*. The line 5 is supposed to be in the act of giving an order to the central

station, and in this case the plug is withdrawn from its position between *a* and *b*, and unites *a* and *c*, thus connecting the main lines with the central office telephones, *t*, and lines 1 and 3 are supposed to be united for conversation, by means of a flexible conductor, *f*, having a plug at each end, which is thrust into the holes in the main part of the plates *a*, a telephone, *t*, was introduced into the circuit of this connecting cord, by which the operator occasionally listened to ascertain if the conversation was over.

This crude organization thus combined all the elements of an actual telephone exchange. Electrical communication exchanges at this time were by no means new. The telephone feature was the novelty.

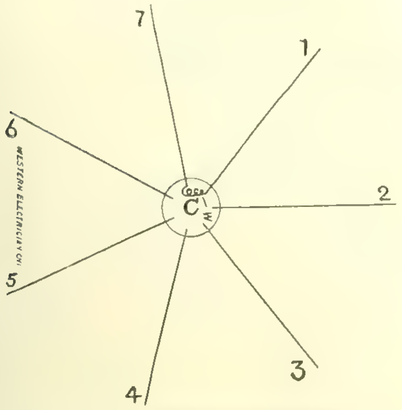


FIG. 29. PRACTICAL TELEPHONY.

Similar systems, in which dial, printing and Morse telegraphs were the communicating agencies, had already been worked to a limited extent by the Gold & Stock and the Law Telegraph companies in New York, the Philadelphia Local Telegraph company in Philadelphia, and by the British government in Newcastle-upon-Tyne, England, but the application of the telephone involved a number of important arrangements, modifications and improvements, which, from time to time, have been devised and applied before its present condition of comparative excellence could be reached. The experimental exchange of Mr. Holmes was the first instance of the employment of telephones in a system of intercommunication.

We know that the chief object of a telephone exchange is to quickly connect and disconnect the subscribers' lines, so that each subscriber may, as he desires, talk with any other, and so that, as soon as any two lines cease to be used, they may be at the service of any other subscriber who wants either of them.

This apparently simple operation, however, requires a great many sub-operations. The first step is that the subscriber must get the attention of the central station; for this purpose there must be at the central station a call-receiving apparatus. Having done this, he must tell the central station operator the name or number of

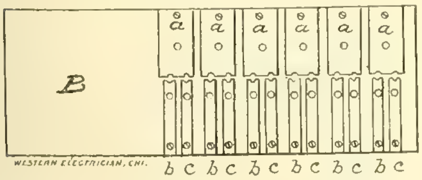


FIG. 30. PRACTICAL TELEPHONY.

the sub-station wanted, and this requires telephone instruments at the central station, and means to connect them with any and all of the subscribers' lines. The next thing is to call the subscriber wanted, and this, of course, implies call-sending apparatus at the central station, and means to connect this with any line. Having attracted the attention of the subscriber wanted, the central office ends of the two lines now must be disconnected from their original terminals and united to one another. This done, the two subscribers can, of course, converse at pleasure. But this is not all. There must also be some apparatus whereby the central station telephones can be connected at will with any two united lines for the purpose of supervising, encouraging and, if necessary, helping along conversation, and apparatus for indicating discon[illegible] signals.

I have [illegible] fully described [illegible] operation, [illegible] I have always [illegible] [illegible] one has a [illegible] of the operations to be performed, [illegible] easy [illegible] comprehend the apparatus [illegible] operat[illegible].

But as I have already said, [illegible] is that of uniting and separating the wires quickly and conveniently. It could no doubt be done slowly and inconveniently [illegible] them all hanging loose about the wall [illegible] selecting and holding or twisting together the two required, but this practice, besides being slow and inconvenient, would be hard on the wires, and, I fear, would not tend toward a good understanding between the subscribers and the telephone companies. Therefore, we want a switch-board. The invention of the telephone led to the evolution of the switch-board. Before 1876 there were, it is true, switch-boards, which were thought to be both convenient and large, and which were used in telegraphy. But, although these had a common function with the telephone switch-board of to-day, that function was in telegraphy but an incidental to the business, while in telephony it *is* the business.

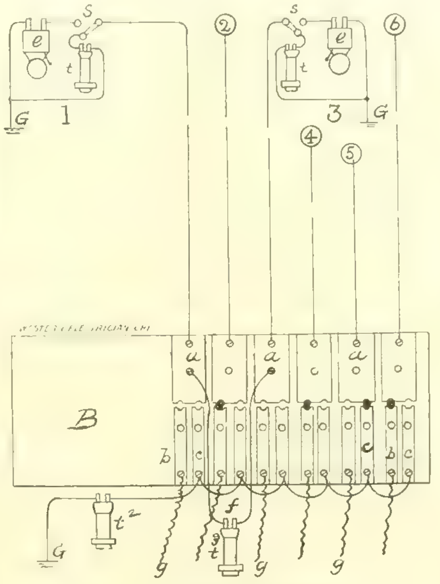


FIG. 31. PRACTICAL TELEPHONY.

The switch-board derives its name from a railroad switch, for, exactly as the latter when turned, directs the train on to another track, so does the telephone switch-board—right or wrong—when re-arranged by the operator, cause the message to traverse the new line. The principle of the switch-board is indicated in Fig. 32, and to the learner may be compared to the lines of latitude and longitude on a map. This comparison requires, however, some latitude, because at the intersections in a switch-board the lines must not ordinarily touch one another, but are quite out of contact, until caused to unite by the insertion at any intersection of a connecting pin or plug, or some such device. Thus in the drawing each longitudinal line has a designating number. Each subscriber's line is united permanently with one of the said vertical longitudinal lines, and has a number corresponding to that line. The lines of latitude, *a*, *b*, *c*, *d* and *e*, may be arranged just behind the vertical lines. But suppose we want to unite the vertical line 2, for example, with the vertical line 4; we can do this by hooking or plugging both of these lines to any one of the cross lines at their intersections therewith, as is done in the drawing, where the two lines are both hitched to the crossline *b*, at the intersections, where plugs *f* are inserted. Now, supposing these lines to be of metal, it will be seen that we have established a continuous electrical conductor from 2 to 4 by way of *b*, and that, if telephone lines be connected to the upright lines 2 and 4, the said telephones are thus made one, and conversation may be transmitted from one to the other.

Instead of using rigid vertical metal rods or bars in a switch-board for the line connections,

[illegible] or insert[illegible]

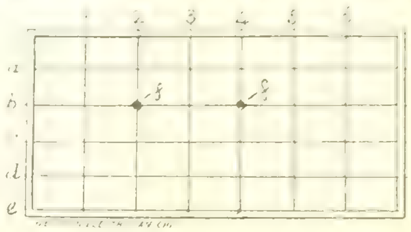


FIG. 32. [illegible]

sockets 1 and 11 and 2 and 8 [illegible] connected through the cords *a* and *b*. All switch-boards are based upon one of these types.

Westinghouse Apportionment of Territory

The Westinghouse company is apportioning territory among its district managers. Charles D. Shain, well known in Chicago and the west, gets the peninsula of Ontario, and the states of Ohio, West Virginia and Kentucky. Mr. Shain is one of the brightest and most successful men in the electric lighting business, and has won an enviable reputation in Chicago. His headquarters after April 1st will be at Cincinnati, and he will have full charge of the Westinghouse company's business in his territory. It is within the bounds to say that no abler man could be found to handle it, and safe to predict that the results under Mr. Shain's management will be satisfactory to all concerned. Besides being a man of unusual business capacity Mr. Shain is a polished and courteous gentlemen, with whom it is impossible to have other than the pleasantest social or business relations. Mr. Shain will enter upon his new and more responsible duties with the best wishes of a host of friends, whose hopes for his continued success will be fully realized.

Chicago Electric Light Plant.

The Chicago electric light plant is now operating fourteen 30-arc light dynamos. It was found necessary to introduce static arresters, as sparks an inch long could be drawn from the iron frames of the dynamos. This was caused by frictional electricity from belts. Now, how-

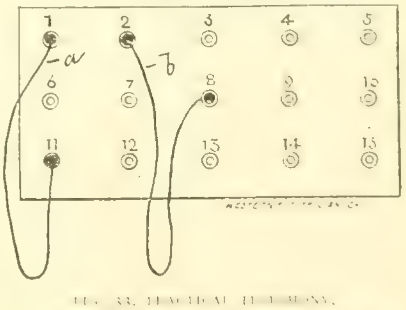


FIG. 33. PRACTICAL TELEPHONY.

ever, the cause of the trouble is removed, and there is no manifestation of static electricity on the dynamos.

Electric Light on a Cable Car.

The new plan of lighting the [illegible] Side cable cars [illegible] passage [illegible] the La Salle street tunnel [illegible] recently. The car, upon entering the tunnel, picks up [illegible] wire [illegible] and the incandescent lamps are lighted. As the train passes out of the tunnel [illegible] the lights are extinguished.

[illegible]

Western Electrician:

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[illegible]

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THAT the greatest interest is being taken at the present time in the use of oil as fuel is shown by the fact that three papers were presented at the convention of the National Electric Light association treating of this subject. It is said that many new experiments will be made in this field in the next few months.

MAYOR GRANT, of New York, has been requested by the Linemen's union to reconsider the order for placing all telegraph wires underground. [illegible] that he did not issue [illegible] most careful investigation [illegible] interests involved, [illegible] reconsider the order.

[illegible] Royal Society appointed a committee to co-operate with a similar [illegible] to promote the [illegible] George Simon [illegible] March 16, [illegible] before the [illegible]

[illegible] work of [illegible] [illegible] orge L. Phillips, [illegible]

company, said he found the matter a most difficult matter to explain satisfactorily to the subscribers, though he considered the question exceedingly simple. Mr. Lockwood's illustration makes the problem simple enough to be patent to the most obtuse subscriber.

THE adoption of electricity as a means of executing capital punishment has made it necessary to coin a word suitable for the new mode. Many terms have been suggested, among the number "Virmort," a combination of Latin words, and "Electrolethe," a combination of Greek words. Elbridge T. Gerry, the advocate of this system in New York, suggests the latter expression.

IN this issue of the WESTERN ELECTRICIAN a paper read at the last meeting of the American Institute of Electrical Engineers is published. Its presentation has been somewhat delayed for the reason that the recent issues of the DAILY WESTERN ELECTRICIAN and the last number of the weekly WESTERN ELECTRICIAN were devoted to the report of the proceedings of the National Electric Light association, which held its ninth convention in Chicago.

THE American Bell Telephone company has won another victory. Last Saturday Benton J. Hall, commissioner of patents, rendered a decision in the matter of the petitions of Gray and McDonough to reopen the Bell telephone interferences and to set aside the decision of Commissioner Butterworth, rendered March 13, 1885, awarding priority of invention to Bell. The commissioner refused to reopen the interferences and reaffirmed the award of priority to Bell. The decision was extremely long. Its essential features are given in another column of this issue.

WE publish this week an illustrated article describing the Zipernowski-Deri system of continuous current lighting. It is worthy of remark that the WESTERN ELECTRICIAN publishes the first newspaper description of this system, distancing the English and even the continental electrical papers. The cuts are reproduced from proofs furnished us by Mr. Zipernowski himself, and the technical description was also furnished us by him at our request. It must certainly be considered a matter for self-congratulation that the WESTERN ELECTRICIAN, published several thousand miles from Mr. Zipernowski's laboratory, should be the first paper to publish a description of this interesting system of electric lighting.

SCIENTISTS had scarcely ceased laughing over the cabbage-leaf incandescent lamp hoax published recently in an English newspaper when the following appeared in another periodical in England: "So far from the electric light pushing gas from the field, it is now being discovered that the managers of electric light stations are likely to become good customers to the gas works. Intense heat is required for the purpose of heating the dynamos, and this cannot well be secured by the use of ordinary coal. Then, again, the coal specially adapted to the business is very expensive—so much so, indeed, is this the case that the officials of one large electric light station are contemplating laying on a main of gas whereby to get the heat required for the dynamos."

[illegible] stated in the last issue of the WESTERN ELECTRICIAN, the proposition to hold a general electrical exhibition in Chicago next February has been taken into serious consideration by the [illegible], and they are now discussing the [illegible]. It is quite probable that the exhibition [illegible], and there is every reason to believe it will be [illegible]. The recent exhibition [illegible] connection with the convention of the National Electric Light association demonstrated the fact that an electrical display possessed [illegible] attraction for people of all classes. [illegible] the display was [illegible], and many were [illegible]. When it is considered that the [illegible] for the recent exhibition were made hurriedly, and that the display was considered a secondary affair in connection with the convention—a side show, as it were—the success attending it is all the more noteworthy and significant. With plenty of time to arrange the preliminaries and undivided attention on the part of exhibitors, a general display of electrical apparatus must be a big success in Chicago. The recently closed exhibition would sink into insignificance in comparison with it, and electric manufacturers would learn for the first time the true extent of the field which they have to operate, and of which Chicago is the center.

It is stated by a member of the committee on municipal corporations of the Missouri legislature that the Dempsey bill, fixing the maximum rate of telephone charges at $48 per year, which has been reported unfavorably by this committee, will be amended when it comes up for engrossment so that the charges shall be fixed at $75 per year. This will be done as a compromise between the telephone companies and the people. The committee believes that $48 is not enough to enable the telephone companies to keep up their business at its present high standard, and will urge the amendment establishing the rate at $75. It will be remembered that the St. Louis Telephone company stated that if the bill in its present form were passed, it would withdraw from business.

THE experiments which have been made within the last few days with the electric locomotive on the Ninth Avenue elevated line in New York city are watched with considerable interest. Trains of eight cars, the longest ever pulled over the road, have been drawn without difficulty. Last week trains made up of four flat cars loaded with railroad iron were readily drawn. Tests of various kinds are to be continued, and larger motors are to be operated. The motor is highly popular with the patrons of the road, as the trains, when using the electric motor, can be started and stopped with greater promptness and less commotion than when the ordinary locomotive is used. Aside from these advantages, the absence of dirt, cinders and gas is highly in favor of the adoption of the electric motor.

A PORTRAIT of Edwin Ruthven Weeks, the new president of the National Electric Light association, appears on the first page of the WESTERN ELECTRICIAN this week. Mr. Weeks is an enterprising, energetic gentleman, whose influence will be widely felt, in the organization of which he is the executive head. Dr. Moses said in seconding his nomination: "He is a man of placid temper, of judicious feeling and inclination, one who is, as he said on a recent occasion, so much in earnest with the development of electric lighting that he has invested every dollar in his possession in that business. That is the best guarantee, to my mind, of the earnestness of a worker, when he puts not only his whole soul but his whole fortune into its action and development."

A brief extract from President Weeks' address in acknowledging his election to the presidency is worthy of reproduction in this connection. "I take your action in large part as a recognition of the great west, as a recognition of the sleepless enterprise and indomitable pluck that is rapidly converting the Great American desert into green pastures, blooming orchards and fields of golden grain, and which have transformed a vast swamp into one of the world's greatest and most beautiful cities. This association now enters upon its fifth year, and while much has been accomplished under the able leaderships of Mr. Duncan and Mr. Morrison, infinitely more remains to be done. The electrical industries lead the van of human progress. In the highest sense of the word the electrical engineer of to-day is the resultant of all engineering experience, and to the engineers of the world more than to all other professions the civilization of the present age is due. Let us remember our high calling, and with one accord strive to advance the National Electric Light association to a still higher place among the world's industrial and scientific societies."

Sprague Electric Railway at Cleveland.

The accompanying cut shows a view of a car on the East Cleveland electric street railway of Cleveland, O., of which Dr. Everett is president. This road has been in operation now for about a month, and is one of the finest roads in the country. The view given was taken from a photograph of one of the electric cars on Euclid

FIG. 1. SPRAGUE ELECTRIC RAILWAY AT CLEVELAND.

avenue, which is one of the streets covered by the electric road, and is one of the finest residential boulevards in Cleveland, if not in the country. The number of cars installed by the Sprague company for this road is sixteen, and each is equipped with lightning arresters, universal movement trolley arms, and all the latest improvements and devices which are in use in the Boston West End road and on the other electric railways which have lately been installed by the Sprague company. Every method has been adopted to make the road first-class in every respect. The poles used throughout the whole distance are of iron of a very neat and tasteful design. The working conductor, which is the only wire suspended over the center of the street, is only 3-16th of an inch in diameter, and can hardly be seen from the roadway. The main current is carried in a conductor running parallel to this conductor, and feeding into it at distances of every 100 feet.

The power station is on Cedar avenue, and is one of the most complete in every detail which has ever been constructed for this kind of work. The dynamos are perfectly noiseless in their operation, and every object in the station is bright, polished, and as clean as any drawing room. It is said that the directors of this road intend extending the line before long.

The second cut gives a view of one of the electric cars on the Lafayette, Ind., electric railway which has been in operation for about six weeks upon the Sprague system. The view was taken while the car was passing Purdue university, which is one of the handsomest buildings in Lafayette. The regular Sprague system of wiring is in use upon this road, only one wire being used over the center of the street, and this is of silicon bronze, 3-16 of an inch in diameter. The main current is carried upon a large copper conductor at the side, which can be increased upon any addition to the number of cars run or extension of the line, without changing the size of the working conductor, or without stopping traffic.

The cars are all brilliantly lighted by electricity. The Sprague lightning arrester is used. The road has been visited by a large number of street railway managers from Illinois, Indiana and Ohio.

The third cut shows one of the electric cars on the Naumkeag street railway of Salem, Mass., of which Mr. Charles F. Odell is president. This electric road was equipped during the last year by the Sprague Electric Railway and Motor company of New York for the summer traffic between the city of Salem and a watering place about two or three miles away, known as the Willows. The cars ran very successfully all last summer, while in use, carrying large numbers of passengers, and giving very perfect satisfaction to the president and directors of the road, who, it is said, intend adding more electric cars in the spring, and extending the line as far as Beverly.

The illustration presents a very good idea of the large number of passengers which these cars often carry on pleasant days during the summer. In spite of the heavy load, these cars move with quickness and dispatch, and mount the steep grades on the line at the rate of eight or ten miles an hour. These grades have been too much for four horses in drawing the heavily [illegible] of the [illegible] conductor.

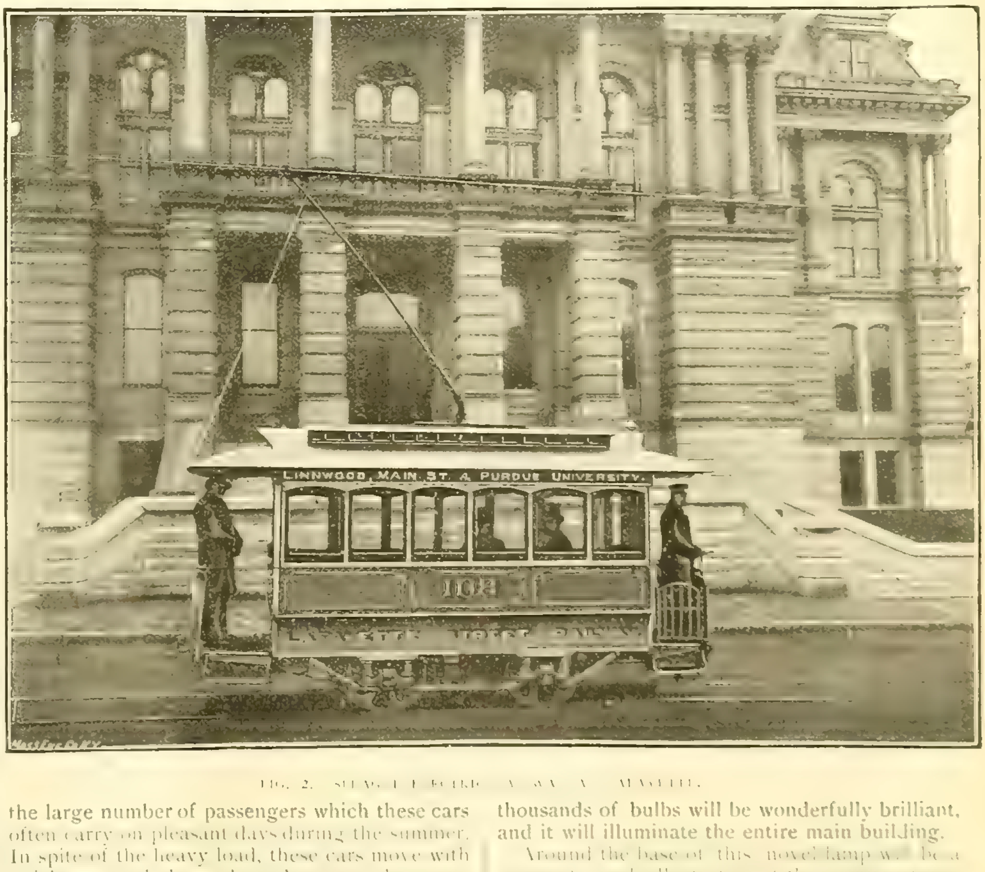


FIG. 2. SPRAGUE ELECTRIC RAILWAY AT LAFAYETTE.

Edison Exhibit at the Paris Exposition.

The [illegible] A. Edison has been busily engaged in sending off articles for his exhibit at the Paris Exposition [illegible]. Nearly [illegible] of the entire floor space allowed to the United States has been given to him, and his preparations are on an elaborate scale. The [illegible] will include a large number of instruments, each of the latest type, with Mr. Edison's latest improved automatic tension regulator. A corps of assistants will be in attendance, speaking nearly all the languages of the civilized world. All the various kinds of instruments will be shown, from the original phonograph now in the South Kensington museum, London, down to the very latest improved type.

The telegraph department will contain models of all the machines and patents that Mr. Edison has worked out and all the improvements he has effected. In the telephone division there will be a chronological arrangement of all the devices from the original Edison instrument, popularly known as the "Blake transmitter," down to his latest improved motorgraph, or loud-speaking telephone. There will be a complete working system set up showing the Edison carbon telephones and the motorgraphs working in juxtaposition. In electric lighting there will be a complete three-wire municipal system extending over all the exhibit, complete with motor, dynamos, central station, and indicating and regulating apparatus, as perfect as if for a large city. The principal feature of the whole exhibit, however, will be an enormous model of an incandescent lamp forty feet high, the globe being composed of no less than 20,000 incandescent lamp bulbs, and the luminous filament within being indicated by a loop of red-colored incandescent lamps. The effect when the light is flashed into these thousands of bulbs will be wonderfully brilliant, and it will illuminate the entire main building.

Around the base of this novel lamp will be a series of panels illustrative of the various stages of the manufacture of incandescent lamps, and on either side will be the French and American flags worked out in colored incandescent globes.

One will be inscribed "Paris," and other "Edison." Among other novelties will be a huge dynamo [illegible] 2,[illegible] lamps, one of the largest dynamos that has ever been constructed. An interesting feature will be a series of [illegible] number, showing the growth and development of all Mr. Edison's inventions, from the first crude idea, through all the successive stages, to the complete and perfected instrument. There will be a number of frames showing the filaments in their natural condition, and after being carbonized, with samples, arranged in chronological order, of all the substances that have been experimented with in this direction.

An interesting map of the first electric central station and district in New York will also be exhibited, with a tabular statement showing the growth of the business from a net loss of $4,457 in 1883 to a net profit of $116,235 in 1888, and this despite the reduction of gas to $1.25 per 1,000 feet, while the equivalent cost of electric light is $2.25.

Three large shipments of several hundred cases have already been made, and the remainder will be packed and shipped within a week or two. The Exposition will open on May 4th, when Mr. Edison expects to have the entire exhibit in working order.

Meeting of the Westinghouse Stockholders.

The annual meeting of the stockholders of the Westinghouse Electric company was held at Pittsburgh on February 12th. The election of directors was, however, postponed for sixty days, in view of the fact that important negotiations are pending with reference to the company's business in England, where large orders have already been received, and also with reference to the immediate business of the company in this country. As the company has recently secured important acquisition in the east, it was impossible at this meeting to make a complete report.

FIG. 3. SPRAGUE ELECTRIC RAILWAY AT SALEM.

George Westinghouse, jr., president of the company, presented a statement to the stockholders, in which he said: "The business during the past year has been prosperous, and the earnings up to December 31st were more than sufficient to pay the usual quarterly dividend of $1\frac{1}{2}$ per cent. During 1888 the company acquired, by lease, the control of the Consolidated Electric Light company and the Sawyer-Man Electric Light company, and the company [illegible] par value of the capital stock of the [illegible] the capital of which is $2,[illegible]. The earnings from [illegible] companies for the first quarter [illegible] rental. In November, [illegible] capital stock ($[illegible]) [illegible] Manufacturing [illegible] inventions. In January [illegible] the principal owner of the [illegible] company, whereby [illegible] months of the stock of [illegible] and whereby that company was re-leased to the Westinghouse company. By the acquirement of the control of the Consolidated and United States companies, the Westinghouse company has secured a favorable position with reference to patents, having now the exclusive rights under the Sawyer-Man patents and numerous other valuable inventions. Already the case, as against the Edison company, licensee, the McKeesport Light company, for infringements of the Sawyer-Man patents, has been before the United States courts for an argument for the fixing of an early date for a hearing, and it is the determination to push the case to a final hearing, believing that the patent in question can be sustained greatly to the enhancement of the property and rights of this company. The orders received for central station apparatus since the 1st of January aggregate a capacity of 50,000 16-candle power lights. Taking the lamps and details generally into consideration, the average price for each 16-candle power light capacity is $8. The number of lamps sold by the Sawyer-Man company in January was 92,000, while the United States company, for the same period, sold 50,000 lamps. The three lamp factories are now capable, with the present machinery, of producing at least 18,000 lamps per day."

Grinding Machine.

The accompanying cut illustrates the universal grinding machine made by the Brown & Sharpe Manufacturing company, Providence, R. I. This machine was the first grinding machine [illegible] for general manufacturing purposes. It has materially modified [illegible] by showing that an [illegible] its introduction, [illegible] commercially impracticable, [illegible] grinding and [illegible] that [illegible] and cylindrical [illegible] soft or hard, can be better and [illegible] by grinding than by [illegible] of the machine [illegible] the place of the lathe in the [illegible] work, and to [illegible] classes of [illegible]

The machine [illegible] for [illegible] of work. It [illegible] 1877.

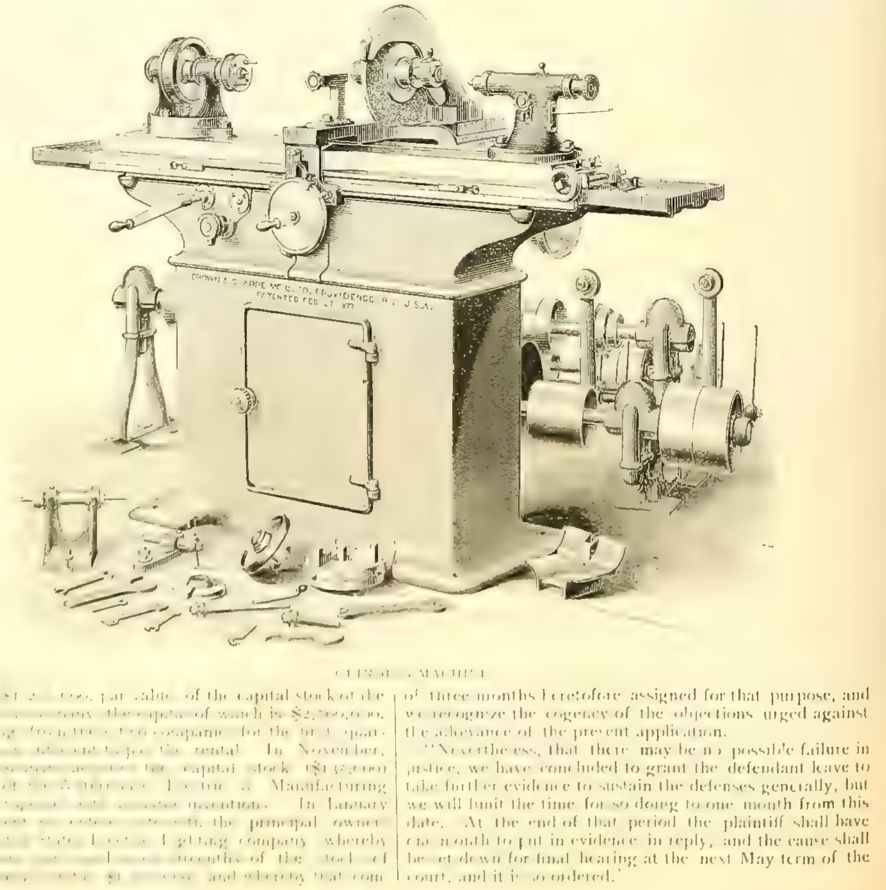
[illegible]

Edison-Westinghouse Litigation.

In the United States Circuit court at Pittsburgh the Consolidated Electric Light company (Westinghouse) made a motion, on the 9th inst., for a hearing in the suit against the McKeesport Light company (Edison) upon the Sawyer-Man fibrous carbon patent, the testimony in which has been closed in that court. This motion was opposed by the New York counsel of the Edison company, who asked the court for leave to file a motion to reopen the case to take further testimony in defense. The court continued the motion of the Consolidated company until the 18th inst., and permitted the Edison company to serve its motion for delay, to be heard at the same time as the complainant's motion for an early hearing. On the latter date the following decision was handed down:

PITTSBURGH, Feb 18.—In the United States Circuit court to-day a *per curiam* decision was handed down in the case of the Consolidated Electric Light company (Westinghouse) against the McKeesport Light company (Edison). The argument attracted unusual attention, not only because of the array of legal talent on each side, but because of the vast commercial and corporation interests involved. The Edison people assumed the fight of the McKeesport company, and contended that under advice they had limited their answer to the bill filed by the Westinghouse or Consolidated company to proving that when Sawyer and Man made application for letters patent, the device described by them for electric lighting was neither new nor novel, having been specified and substantially described in an article published in a New York paper several years previous to the date of application. The argument lasted an entire day, and the extension was opposed most vigorously, the Westinghouse interests contending that the motion was simply to delay a final determination of the question.

The *per curiam* decision as rendered is as follows: "It is very evident to us that as a matter of strict legal right the defendant is not entitled to an order allowing the introduction at this stage of the case of evidence in chief. It was the duty of the defendant to put in the proofs in support of such of the defenses as were relied upon within the period



GRINDING MACHINE.

of three months heretofore assigned for that purpose, and we recognize the cogency of the objections urged against the allowance of the present application.

"Nevertheless, that there may be no possible failure in justice, we have concluded to grant the defendant leave to take further evidence to sustain the defenses generally, but we will limit the time for so doing to one month from this date. At the end of that period the plaintiff shall have one month to put in evidence in reply, and the cause shall be set down for final hearing at the next May term of the court, and it is so ordered."

Lightning Arresters and the Photographic Study of Self-Induction.[1]

NOTES ON E. G. ACHESON'S PAPER, BY JOS. STAN[illegible] BROWN AND CHARLES L. CHILD.

Having been requested upon very short notice to reopen the discussion on the highly interesting paper on

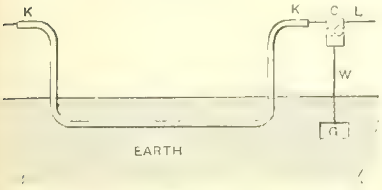


FIG. 1.

"Lightning Arresters and the Photographic Study of Self-Induction" presented at the Institute meeting held Jan 8th, the following hasty notes and queries are with diffidence offered for consideration. Truth alone is sought, and it is a matter of regret if any criticism should even tend to disparage the worthy endeavors of one who has so fearlessly grappled a problem fraught with such interest alike to both theorist and practical electrician.

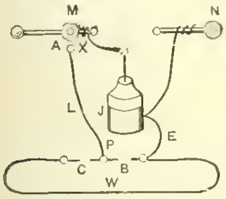


FIG. 3.

After careful reading it would seem as if the subject might be approached with advantage from more than one standpoint, and that even somewhat different conclusions were deducible simply by rearrangement of the experimental data. We have given a submarine or subterranean cable, to each end of which at its junction with the main line a lightning arrester is connected in the most

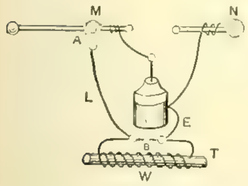


FIG. 5.

approved manner, Fig 1, to determine why, in spite of these precautions, the cable is not infrequently punctured when an "electrical discharge" enters the overhead system.

For experimental purposes this has been reproduced in miniature, as shown in Figs 2, 2a, 2b and 2c, by the line *L* entering the cable *K* at the point *P*, to which point is attached the lightning arrester *C* grounded through the

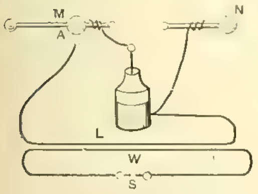


FIG. 6.

wire *W*. The "electrical discharge" arises from the Leyden jar *J*, charged from the Holt's machine *M N*, and strikes the line at *A*. The outside of *J* will represent the earth, to which the ground wire *W* and the "earthing" of the cable, represented by *E*, "twisted a single turn" (WESTERN ELECTRICIAN, IV., 47) about the cable, is connected. Is it not possible, then, to throw Fig. 2 of the

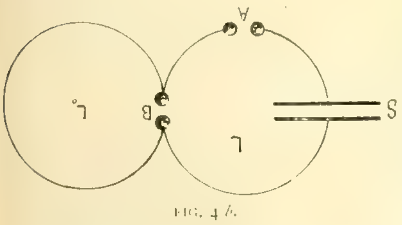


FIG. 4 b.

previous paper into the form Fig 2a for the purpose of drawing attention more directly to the relation of the circuits involved? The discharge, or momentary current, from the jar *J* entering at *A* traverses the line *L* to the point *P*, where two paths are offered; one, through the lightning arrester *C* to earth. *E*, a second, in [illegible] puncturing the cable insulation. *C* now being a [illegible] fraction of the insulation thickness, and *W* a [illegible] copper wire, it was found that the cable was [illegible] punctured at times when a spark appeared at *C*, and that the length of *W* appeared to enter the effect [illegible] the space variation of *C*. No part of the effect, it [illegible]

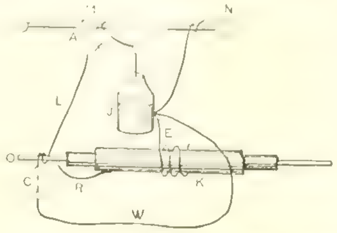


FIG. 2.

noted, is attributed to the action of the cable as a condenser.

The problem is now changed to that shown in Figs. 3 and 3a, presenting a divided circuit with the lightning arrester at a constant distance of .02 inch and the earth wire *W* long compared with that connecting the variable *B* space with the same earth point. May not this arrangement of split circuit with an air space in each branch be

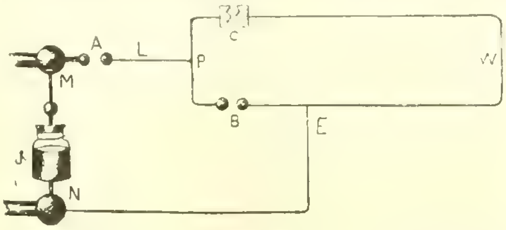


FIG. 3 a.

looked upon as the general case for which Dr. Lodge's "alternative path" represents the condition of making one of the air spaces zero? What, then, is the relative efficacy of changing the length of *W* and the distance of the *C* points to prevent a spark at *B* which represents the puncturing of the cable insinuation, providing the *B* points are held equivalent to the long length of cable wire at any

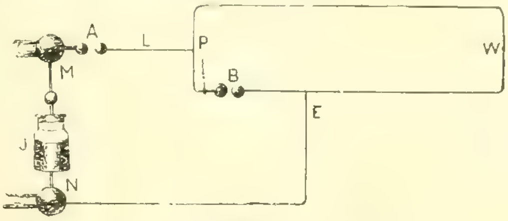


FIG. 4 a.

point of which puncturing may occur?

To decide this with *A* and *C* fixed at .286 and .02 inch, respectively, *B* was varied with *W* to keep the spark ratio of *B* to *A* constant at one to ten Then removing *C* (*i. e.*, for *C* equal zero) the operation was repeated, and a comparison of these results is shown in the curve, Plate *I*. Instead of this procedure, should not *B* have been

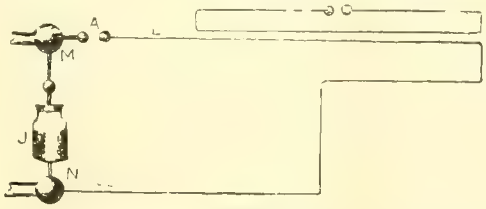


FIG. 6 a.

made non-sparking for *C* and *A* fixed, and *W* varied until a spark was got at *B*, and then W left constant for variations of *C* up to a point where *B* would spark?

That with the connections of Fig. 4 and *W* equal 20 feet a spark should pass at *B* of over ¼ inch in length might perhaps have been expected from Dr. Lodge's results (London *Electrician*, XXI., 815), shown here in Fig.

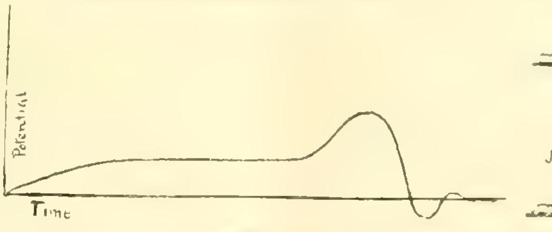


FIG. 7.

4b, when there is an alternative path in which the self induction of *W* (Lodge's *L* loop) comes into play. True, Fig. 4 is not an "alternative path" of necessity, for the *B* points may be moved out of the sparking distance.

W is now supposed "electrified" by the charge across *A*. The "inverse extra current" of making simply cuts from the charging current; but the "direct extra current" of

[illegible]

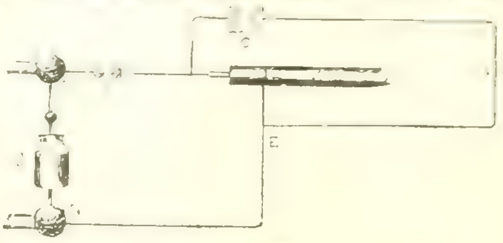


FIG. 2 [illegible]

[illegible] the *L* [illegible] loop [illegible].

It would be of interest to some in this connection to know [illegible] ascertained that the [illegible] duration of the extra current is [illegible] the charging current; for if this be assumed, because of the known higher electromotive force of the former, the argument would seem to be [illegible].

On the assumption that the extra current dissipates

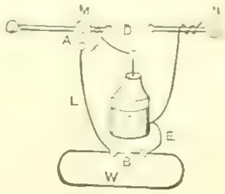


FIG. 4.

through *B*, and not in the earth, it is argued that shortening *W* would tend to decrease this tendency to puncture the cable. To test this we have *B* equal the insulation thickness, *C* and *W* removed, and we get Fig. 2b if the *C W* circuit be supposed omitted. "With this arrangement it was not found possible to puncture the cable." May not this be regarded simply as a safety short circuit for our

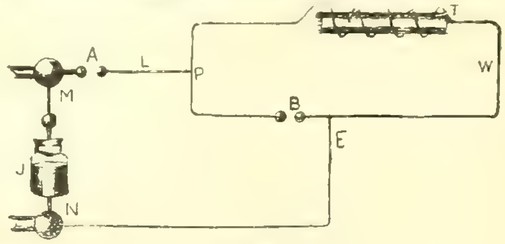


FIG. 5 a.

cable considered as a Leyden jar? And what is this but a working case of a cable effectually protected by lightning arrester *B*? While the electrostatic capacity of a "short piece of cable" may be negligible compared with that of twenty feet of No. 16 B S. wire, it is perhaps doubtful if the capacity of a commercial cable could be so regarded in comparison with that of the ground wire from the lightning arrester

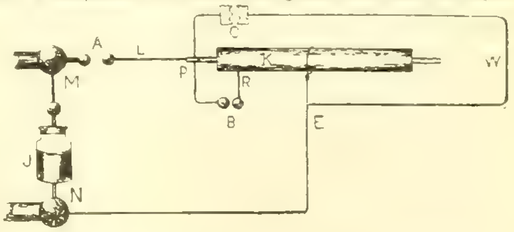


FIG. 2 b.

It is not altogether plain how the direct extra current is an effect of Faraday's electro tonic state when Faraday says ("Researches," I., 16): "This state is altogether the effect of induction exerted, and ceases as soon as the inducing force is removed. And Jaquet ("Dictionnaire d'Electricité et de Magnetisme," 1887, p. 138) defines it as

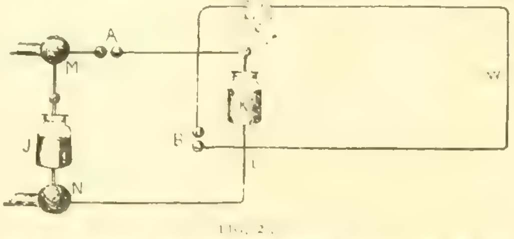


FIG. 2 [illegible]

"the state of the conductor during the interval of time which separates the appearance and disappearance of an induction current." Maxwell by the way ("Electricity and Magnetism" [2d Ed.], II., 174) [illegible] fundamental quantity in the theory of electro-magnetism. Would it not be possible to regard it as an electro-magnetic potential stored in the wire ready to show itself as

[1] Read before the American Institute of Electrical Engineers, Feb. 12, 1889.

direct extra current? With the citations quoted above, how can this electro-tonic state exist before the electrifying current is discharged into the circuit?

[illegible] effects of different kinds of work introduced into the circuit. For references see [illegible] Electrical Artisans," pp. 44, 45 [illegible] Maxwell, "Electricity and Magnetism," [illegible] Dove, Poggendorf's [illegible] XLIX [illegible].

The method [illegible] photographic part of the investigation [illegible] some doubt on the results claimed. The effects noted deal chiefly with the prolongation or diminution of the current wave of the jar discharge by the secohmic resistance cut into the circuit. Might not a large element of uncertainty be introduced in the plates by the different degrees of illuminating power possessed by the sparks and by the irradiation of the plate?

In the cases when [illegible] discharges are through 76 and 20 feet inches of the same wire, respectively, hardly any difference appears in the spark. Is it not possible that the illuminating power of the quick, bright spark through the short wire was so much greater than that of the necessarily more extended and consequently fainter spark through the long wire as to make the effect practically the same?

In the experiment in which two spark intervals are included in the circuit, as against one, formerly, it was found that the spark was materially lengthened. This might be expected considering the practically infinite resistance of the second air space which is introduced. The spark length, too, was found inversely proportional to any

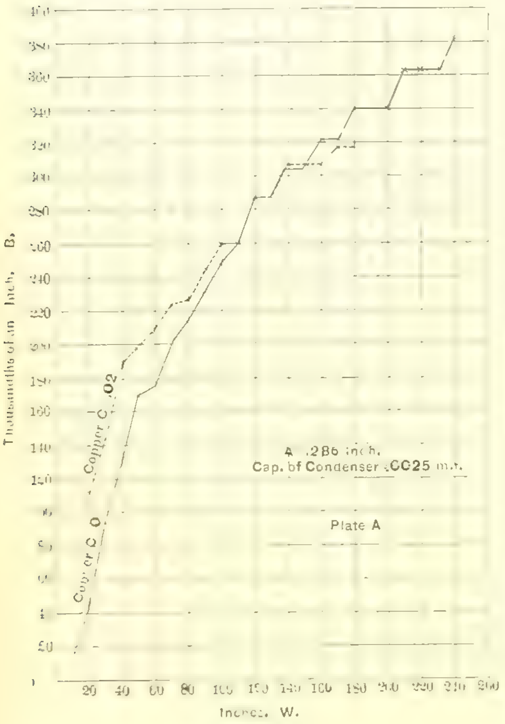


PLATE A.

form of work introduced in the ground wire circuit. Possibly the photography of spark durations is not altogether the best method of measuring them. It is not yet by any means certain that a sensitive plate is equally affected by small equal time intervals at the beginning and end of the exposure, nor is it improbable that with sharp-edged holes moving at an extremely high velocity some diffraction phenomena might intervene that would introduce serious errors in the photograph. It is, besides, very difficult to measure the faint trails of light left by the spark. On the negatives they are practically invisible and in the prints their extreme delicacy and the fact that they fade away into the surrounding blackness without any sharp line of demarcation renders them almost impossible of measurement. [illegible] the measured spark distances of the first part of the article are probably more trustworthy [illegible] than the photographic results of the [illegible].

[illegible] why may not the [illegible] current from A, Fig. [illegible] back up its [illegible] to ground [illegible] at C. [illegible] a near [illegible] Fig. [illegible] ned out by the self-induction effect of [illegible]

[illegible]

CORRESPONDENCE.

New York Notes.

NEW YORK, Feb. 21.—A protest against the passage of the bill now before the assembly committee on railroads, to rehabiltate the New York Cable Railway company, was sent to Albany by Mayor Grant on the 18th. In the opinion of the mayor, the bill is "inimical to the best interests of the people of this community, and assails public rights." In the first place, he says, the bill is special in character, though general in form, and, therefore, repugnant to the section of the state constitution which forbids the passage of private or local bills, and provides that the right to lay railroad tracks shall only be acquired under general laws. As it undertakes to give the Cable Railway company the right to build surface as well as elevated railroads, it also violates the General Railroad act of 1884, which provides that surface railways shall derive their right to existence only from itself, and prohibits composite railroads from being constructed and operated under the authority of the Rapid Transit act of 1875, under which the Cable Railway company has acted.

Mayor Grant adduces another reason for opposing the bill by showing that, while the Cantor act of 1886 requires railway franchises to be sold at auction to the bidder who will give the highest return to the city, it gives a franchise absolutely to the Cable Railway company for the minimum compensation fixed by the General Railroad act. This compensation seems to him insignificant and inadequate, and would undoubtedly be increased at a public auction. The mayor fails to perceive any justifiable reason for excepting the corporation from the provisions of a law formed for the public benefit under such conditions.

After giving a history of the Cable Railway company and of its reverses in the courts, which this bill is designed to enable it to overcome, Major Grant points out that the bill does not compel the company, in case it should acquire the right it seeks, to give a bond to indemnify the public or private citizens for damages to which it would subject them; that the company's railroads are not essential to or productive of rapid transit; that it would really impede the solution of the rapid transit problem, and that the passage of the bill would help to establish an enormous speculative monopoly. The major says: "Should it become a law, it would prove a formidable obstacle to the formulation and execution of a comprehensive scheme of rapid transit, for which there is great need in this city, and which is now receiving my best consideration. It is not claimed that the cable system will give the people rapid trainsit in the sense in which it is understood in this city. It can, therefore, serve only to impede that result by claims in favor of the cable upon thoroughfares, the use of which would be essential to structures, either elevated or underground, which would be required for a system of rapid transit adequate to the needs of the public."

There has been a commotion this week at the office of the Electric Sugar Refining company, 69 Wall street. President Cotterill, Secretary Robertson and Director Lawson Fuller, have been holding warm and lengthened sessions in the endeavor to find out to whom the glory belongs of securing the arrest of Mrs. Friend, her stepfather, W. E. Howard; her mother, Emily Howard; O. A. Halstead and George Halstead, who are charged with conspiracy.

To whom the credit is due is of less importance than the fact that the arrest has been made, and the president states that he now hopes to recover a considerable amount, and that there will be a dividend to the shareholders. The property of the people arrested on charge of defrauding the company has been attached wherever it could be found. Its assessed value is $26,000; actually it is supposed to be worth about $40,000. There is something like $30,000 in the treasury of the company. The value of the plant at the Brooklyn refinery, and of the sugar stored there, is put, in round numbers, at $10,000. This makes a total of $80,000. Altogether there are 10,000 shares of stock of a par value of $100 each. Mrs. Friend, as an inheritor of her husband's holdings, had [illegible] shares. The remaining [illegible] shares, if they can keep the assets to themselves, will get a dividend of about [illegible] per cent., estimating that the legal and other expenses will take about $15,000.

Up to January [illegible] the expenditure of the company amounted to [illegible]. Of this sum $30,000 had been spent by the company in altering and improving the factory in Brooklyn, and $[illegible] had gone in machinery. [illegible] about $120,000, the [illegible] and about $15,000 more [illegible]. This is the statement of the company [illegible].

[illegible] of the Patent [illegible] a few days ago, [illegible] by Emil Berliner for a [illegible] a telephone transmit[illegible] here. The market value of the Bell company's shares has advanced because of a report that this action will have the practical effect of extending the Bell patents, which expire in 1893 and 1894. It appears that the Berliner application has become the subject of a favorable decision on the part of the board of examiners. The president of the Bell company says that it is one of the patents connected with a transmitter, but he denies that it is a bottom patent, or that the issue of it would be equivalent to an extension of Bell's patents.

The special term of the Supreme court in Brooklyn will soon have a case of great interest to Coney Island residents. The Atlantic Cable company, some time ago, applied for a charter to build a road along Surf and Sea Breeze avenues. The application was made to the highway commissioners of Gravesend, and was rejected. Lately the same board granted a charter to the Electric Surface Railroad company for the same route. The cable company obtained an order from the Supreme court for the highway commissioners to show cause why the first charter was not granted. It is charged that some of the commissioners were actuated by corrupt motives. The defense is that a committee of citizens, after an investigation, are in favor of the electric road.

The American Institute of Mining Engineers, now in convention in this city, visited the Spiral Weld Tube works, near Newark, yesterday, and afterward went on to the Edison laboratory, where they were welcomed by Mr. Edison, who had had a bountiful lunch prepared for them. Papers were read on "The Magnetic Concentration of Iron Ores," by John Birkinbine, of Philadelphia, and T. A. Edison; "The Application of Electric Accumulators, or Storage Batteries, in Mining," by P. G. Salon of Philadelphia, and on "The Brush Plant at Virginia City, Nev.," by Nelson W. Perry of Cincinnati.

The institute is still in session, and among other papers to be read are "The Venstrom Magnetic Separator," by R. A. Cook; "Notes on the Electrolytic Assay of Copper," by W. Glenn, Baltimore; and "The Yellowstone Geysers," by Arnold Hague, Washington, D. C. P.

St. Paul

ST. PAUL, Minn., Feb. 23.—Miles & Hale have just completed a 250 light incandescent plant in the large wholesale grocery house of Beaupre, Keogh & Davis, this city. The Dorman system of Holland & Thompson Manufacturing company of this city is used. Miles & Hale have also wired the Saulpaugh House at Mankato, Minn., for electric lights, call and return call bells throughout, using the Dorman system of lighting and Partrick & Carter annunciators.

The Spaulding Hotel at Duluth and the new hotel at West Superior each has been lately furnished with electric bells and return call system of the Partrick & Carter make and furnished by this firm.

Annunciator work has also been completed by Miles & Hale, in Little Falls (Minn.) Hotel, where a 50 call annunciator system was introduced, and a 125 return call in Grand Forks (Dak.) Hotel. Both were the Partrick & Carter system.

C. Gotzian & company have introduced the Western Electric company's automatic fire alarm system in their extensive building.

The Grand Forks electric light plant, Thomson-Houston system, put in by the Northwest Electric Construction & Supply company of this city, is operating to the satisfaction of all. Two 500-light incandescent machines are in use.

The Northwest Electric Construction & Supply company has installed an 800 light machine of the Fort Wayne Jenney company make at Bismarck, Dak., and another of the same make and capacity at Madison, Wis.

The Faribault plant has been increased from 500 to 1,200 light capacity. A 400-light outfit, Thomson-Houston alternating system, has been shipped to Huron, Dak., and the Hastings plant is getting a 650 light increase. At the latter place a new building is being erected to facilitate business.

It is authoritatively announced that a company for commercial lighting is organizing in Minneapolis, to be known as the Minneapolis Thomson-Houston company. A station of 1,000 arc light and 10,000-incandescent light capacity, with all wires underground, is contemplated. The organization is not yet completed, pending the granting of the franchise, which is expected within thirty days. C. A. Daugh will be general manager of the new company.

The telephone company is trying to secure permission from the city to put its wires in a separate subway conduit of its own. It objects to burying its wires in conduits in conjunction with other branches of electrical service.

The Mather company recently completed a 300-light plant in the shoe factory of Gotzian & company, of this city. Work in the *Pioneer Press* building has been started

under the superintendence of A. D. Adams, electrical expert for the Mather company. Dynamos of 2,000-light capacity are being placed, and wiring will be done for 2,400 lights. Mr. Adams will commence operations soon on the Aberdeen Flats, where an 800-light plant, Mather system, will be installed. An electric light company has been organized at New Ulm, and nearly all the stock subscribed. City and commercial lighting will be done with both arc and incandescent systems. W.

St. Louis, Mo.

St. Louis, Mo., Feb. 16.—The St. Louis lighting contract will soon be the prize for which the electric light and gas companies will compete. This contract calls for the lighting of an immense territory, reaching from Cherokee street northward to the city limits and from the river westward to the city limits. The lighting is divided into two districts—one north of Washington avenue, the other south of Washington avenue. A certified check for $5,000 is required for each district, and $500 per day shall be forfeited if the contract is not fulfilled. John H. Thompson and John H. Lionberger of the St. Louis Gas company have consulted the gas commission, but they made no definite proposition for the sale of their plants. They requested, as a preliminary thereto, that the commission examine the books of the company in order to form an opinion upon which an offer might be based. Capt. John P. Keiser, president of the Laclede Gas company, will be questioned by the commission and invited to submit an offer, if the company should be disposed to make one. Later the books of both companies will be examined by the commission.

The St. Louis Illuminating company is putting in another 125 horse power boiler.

George J. Percival has opened an office at 515 Olive street. He will deal in incandescent lamps of all systems and sizes, and represent the Hawkeye Electric Manufacturing company and the Woodbury Engine company.

The Missouri Electric Light & Power company, recently organized to operate the Westinghouse system of incandescent lighting, will establish a central station, having a capacity of 50,000 lights. The station will operate day and night, and lights will be furnished to business houses and offices by meter. S. M. Dodd is president of the new company. It is understood that the work of construction is being pushed forward rapidly. Twelve thousand lights are to be in operation May 1st.

Eli S. Sanderson of the National Carbon company has been in the city for a few days.

The St. Louis Board of Underwriters have adopted the New York board's rules with regard to electric light and power wires, and a competent inspector will enforce their provisions. The U. S. inspector of electric light plants has been in the city for a few days testing the new Custom house plant. B.

THE ELECTRIC LIGHT.

Chehalis, Wash. Ter., is erecting an electric light plant.

An incandescent plant is contemplated at Roanoke, Va.

The Sherman Tex., Electric Light & Power company will install an incandescent plant.

The Western Electric company, Chicago, has sold a 12 light arc plant to Deck & Unrath, Green and Fulton streets, Chicago.

Racine, Wis., has contracted for 119 electric lights, at $50 a year per light until 12 o'clock, and $75 a year per light for all night.

The Boonville, Mo., Electric Light company has been organized, with John Cosgrove, president, and Z. F. Gmelich, secretary. The capital stock is $10,000.

The plant of the Fostoria, O., Electric light company was completely destroyed by fire last week; loss, $10,000; insurance, nominal. The plant will be rebuilt as soon as possible.

The Western Electric company of Chicago has been awarded the contract for wiring Harlow N. Higginbotham's beautiful residence, corner Michigan avenue and Twenty-ninth street, for 500 incandescent lamps.

The Thomson-Houston company reports the following recent sales: Troy, O., 600 alternating lamps; Rensellaer, Ind., 600 incandescent lamps; Astoria, Ore., 50 arc lights; Nashville, Tenn., for city lighting, 150 arc lights and 600 incandescent lamps, alternating system; Nugent Brothers, St. Louis, Mo., 25 arc lights, 300 incandescent lamps; Austin, Minn., 600 lights, alternating system; Edison Light & Fuel Gas company, Grand Rapids, Mich., 100 arc lights. The Alliance, O., Street Railroad company has increased its plant by 25 arc lights, and the Warner Ore company of Nashville, Tenn., which recently installed a plant in one of its foundries, has just ordered the two remaining iron works in the same place fitted up with Thomson Houston arc light plants.

At a recent meeting of the Wheeling, W. Va., council the following resolution was adopted: That a joint special committee of six be appointed, whose duty it shall be to recommend and petition the legislature, at the earliest day possible, to grant to the city of Wheeling such powers as are necessary for the purpose of building electric [illegible] the benefit of the city, and such other power [illegible] necessary for a more economic and better city government.

The following installations are reported from St. Louis: St. Louis [illegible] incandescent system by the Westinghouse company; American Central building, by the Missouri Electric Light & Power company.

The accident in the Owings building, Adams and Dearborn streets, Chicago, February 17th, broke a large number of incandescent wires. The Western Electric company, which is wiring the building, has received an order to repair the damage immediately.

The Brainerd, Minn., council has requested the Crow Wing county representative to introduce [illegible] passage of two bills, one to legalize the [illegible] council in guaranteeing $40,000 electric light bonds, and the other to authorize the city to issue bonds for $[illegible] to pay for incandescent plant just completed.

Among the recent sales of the Queen City Electric company, of Cincinnati, O., are the following: Two machines for the McMicken university; two 300 light dynamos for the Public Library building; and two, aggregating 750 lights, for the American Oak Leather company [illegible] for the Mt. Adams & Eden Park inclined railway in Cincinnati.

A dispatch from Sedalia, Mo., under date of Feb. 23d, says: For some time the city council has had under consideration the lighting of the city wholly by electricity, and advertised for bids for that purpose. Five companies submitted bids, and when these were opened there was quite a stormy meeting of the council, the committee on lights reporting in favor of the adoption of the bid of the Sedalia Electric Light company. That meeting adjourned before any of the bids had been accepted. To-night a special meeting of the council was held, and the Sedalia company's proposition accepted for 100 arc lights at $87 50 per light per year. No sooner had this resolution been adopted by the council than an ordinance was presented asking for a franchise for James Green, L. M. Rumsey and other gentlemen from St. Louis, to erect and maintain an electric light plant in Sedalia. These gentlemen submitted one of the five bids, and are determined, if a contract is made with the Sedalia company, to establish a competing plant.

THE ELECTRIC MOTOR.

London promises to operate an electrical road sweeper at an early day.

Eureka Springs, Ark., is considering the question of securing electric street railroads.

The commission appointed by the Omnibus company of Milan, after careful investigation, has made its report, and it is quite probable electrical power will be utilized in the line between Milan and Monza.

C. W. Price of the Daft Electric company is supervising the construction of the power station of the Plainfield Avenue electric road at Newark, N. J. The Daft company will also extend the Mt. Adams electric railway into Eden Park.

At the Mason & Hamlin Organ company's factory, Boston, air is furnished one of their instruments by means of an advance battery and a "C. & C." motor. The experiment is attracting attention, and has thus far proved practicable.

The Thomson-Houston company has been awarded the contract for the electric railway at Rochester, N. Y. The road will be ready for operation June 1st, when sixteen cars will be run. Each will be supplied with two 15-horse power motors. The overhead system will be adopted, and the cars will be lighted by electricity.

H. O. Woodruff of Des Moines, Ia., reports the sale this month of a large Hawkeye power dynamo for Des Moines, Ia.; also a 6 horse power Hawkeye motor for the Leader Printing company; a 3 horse power Hawkeye for P. C. Kenyon, printer; a one-half horse power Hawkeye for Antonio Doviddio, cutter, and a 1/8 "C. & C." for Cross Manufacturing company, all of Des Moines.

The successful operation of a 300 ton drawbridge over the Pequannock river at Bridgeport, Conn., recently, by a 1½-horse power motor, opens a new field for the machine. The current for operating the motor is furnished by the Bridgeport Electric Light company. By a system of gearing the 1,600 revolutions made by the motor are reduced to nine revolutions per minute when applied to the work of turning the bridge. This gives a very steady and reliable power, and is proving very satisfactory to its projectors. The bridge is operated at least twenty times each day.

The Sprague road at Asheville, N. C., was recently opened. The trial trips were successful in every way. On the return trips the cars were stopped at the foot of one of the heaviest grades on the line, and six good horses were attached to one of the rear cars to show the difference between the speed of cars propelled by horse power and by electric power. Although the cars were equally loaded, the first cars, propelled by Sprague motors, climbed the hill with perfect ease, stopping whenever their occupants wished to laugh at their less fortunate companions who were laboring slowly along far in the rear. The Asheville *Citizen* says: "The gentlemen in the last car decided that they did not wish any more one horse railroad nor six horse railroad hereafter. The working of the electric system was absolutely perfect. A representative of this paper made a point of interviewing the mayor, each alderman, and as many other guests as he could meet, asking, 'How are you pleased?' But one reply, 'Splendid, far better than I ever imagined it could be done,' was made." Besides this electric railway, there are a large number of stationary electric motors in operation in Asheville, doing a great deal of the business in that city. The *Citizen* and one or two other of the leading papers are printed by electric power, and a large number of other industries are using this same power, which is so convenient, reliable and economical.

Miscellaneous Notes.

[illegible]

connection."

The latest contributions to the Sibley college, Cornell university, [illegible] include a [illegible] horse power, made especially for the university. It has been received and, with the Edison dynamo, and other additions to the equipment, adds several thousand dollars to the value of the collections. [illegible] received about five thousand dollars' worth of material from friends, since the opening of the college year, and a few hundred dollars' worth by purchase.

The Electrical Accumulator company [illegible] has begun a second action in equity against the Julien Electric company, charging infringement of the Sellon patent covering the use of an alloy plate in secondary batteries; damages and an injunction are asked. The same corporation has also instituted suit in equity against the Gibson Electric company on three several patents of Faure, Swan and Sellon, covering improvements in secondary batteries.

Application for a patent for an electric light method of instantaneous photography has been made by two gentlemen of Dubuque, Ia. The application is designed especially for the detection of burglars. The apparatus can be so arranged that a burglar in entering a bank, store or dwelling will in his operations touch something which will cause a flash and the result will be his photograph left indelibly on the plate. A number of cameras may be placed in the room, and a variety of views taken simultaneously. The tell-tale wire can be fastened to the knob of the safe or door so that the intruder cannot avoid touching it.

"I never believed that electricity could affect a watch until I visited the electrical exhibition down at the Exposition building last week," remarked a young lawyer to a Chicago *Herald* reporter. "My watch has always kept good time, and, although I have often been in the neighborhood of dynamos, and my watch is unprotected by any sort of anti-magnetic shields, I never had any trouble with it until last week. I went down there, and I guess the strong currents generated by the various machines must have affected the timepiece. Why? Well, I didn't exactly have the watch along with me, but I had the ticket for it in my vest pocket, and when I examined it yesterday morning I found that the interest had increased 10 per cent., and when I took it out I found it was magnetized. It is wonderful what electricity will do." And the rising young lawyer's friend fell off of his chair.

Personal Paragraphs.

M. E. Baird of the Eddy Electric Manufacturing company was in Chicago last week.

Walter K. Freeman, general manager, and Carl Kammeyer, superintendent of the National Electric Manufacturing company, of Eau Claire, Wis., entertained a party of friends at dinner at the Sherman House, Chicago, Feb. 23d.

At a meeting of the directors of the Sawyer-Man Electric company in New York, the resignation of H. M. Byllesby as general manager was accepted, and P. H. Alexander was promoted from assistant general manager to general manager in his place.

Business Mention.

The Empire City Electric company of New York has just issued a new catalogue, which will be mailed on application.

The Ashton Valve company, Boston, manufacturers of the pop safety valves, have opened a branch office at [illegible] Liberty street, New York, in charge of Charles H. Buckelew.

The headquarters of the western department of the Electrical Accumulator company, New York, [illegible] Hood, managers, has been removed to 502 Phenix Building, Chicago.

A. C. Kemper, of Lake street, Chicago, had a fine display of his magnesia pipe covering at the electrical exhibition of the National Electric Light association. The covering is becoming deservedly popular.

We are informed that the Standard Underground Cable company of Pittsburgh has captured the St. Louis wire order for which most of the wire companies have been competing. It amounts to [illegible] lbs., [illegible].

The National Telephone Manufacturing company has established its offices in the handsome new Hathaway building, 620 Atlantic avenue, Boston. This company was incorporated in August, 1888 with a paid up capital of $[illegible]. Woodward Emery is president; S. K. [illegible], treasurer, and John E. Bennett, general manager. The company has acquired a large number of important patents pertaining to acoustic telephony, among them those [illegible]

respectively, Lakin, Gilliland, Bennett, Coombs and Lord. The company is the exclusive manufacturer of the well and favorably known "Bennett" telephones, and reports a [illegible] general trade.

[illegible] N. Y., has just patented an automatic fire alarm attachment for electric push buttons. [illegible] simple and efficient fire alarm system.

The Bernstein Electric company has been formed in Boston for the manufacture of electrical appliances. It will [illegible] series incandescent lamps. This company succeeds the Bernstein's Electric Light Manufacturing company.

The Central Electric company, 42 La Salle street, Chicago, [illegible] a neatly printed catalogue and price-list, issued by the Okonite company, which it represents. The catalogue contains much valuable data and many excellent illustrations, besides the price list of the company.

Hon. Chauncey M. Depew is having all the old work taken out of the handsome house formerly owned by Dr. Hammond, Fifty-fourth street, New York, and the special electrical appliances are being furnished by Edwards & Co., manufacturing electricians, New York, such as burglar alarm, electric gas lighting, bells, etc.

A letter from the Western Engineering company relating to the removal of the company's headquarters from Lincoln to Kearney, Neb., says: "The change has been made to gain larger facilities in transacting a rapidly increasing business. With the change in location and a largely increased paid up capital, the company has put itself in condition to handle its business with greater promptness than before. The company has lately started isolated incandescent plants Mather system, in the county courthouse at St. Joseph, Mo.; Institution for Deaf and Dumb, Council Bluffs, Ia.; and mill of Lincoln Paper company, Lincoln, Neb. It has also started central stations of the Westinghouse system at Red Cloud and Beatrice, Neb., each of 650 lights, and has under way a station of 2,000 lights at Council Bluffs, Ia. At Beatrice the plant was installed, accepted, and payments received within a month after the contract was signed. This can surely be accounted good progress. The company has just contracted to put in an electric tramway one mile in length to haul clay for the Kearney Brick company, at Kearney, Neb., using the Sprague system."

The Electrical Supply company of Chicago has recently put on the market a double pole extra test cut-out. In this apparatus terminals are furnished for an extra fuse, which normally is not in circuit. When there is trouble on the line the operator can determine whether it is a permanent cross or a momentary trouble which "blew" his fuse, by merely screwing down upon the thumb screw centrally located upon each side, which brings the test fuse into action. As this has the same capacity as the first, the lights will instantly start or show that there is permanent trouble by also "blowing" the test fuse. It many times happens that fuses are burned out simply because the contact in the fuse itself is not good, or on account of momentary trouble on the line; and it often happens that much time has been lost where the real trouble has all been in the fuse itself. New fuses can be readily placed with less difficulty and danger to the operator than in any other form. The company has recently entered into an arrangement with the Cobb Vulcanite Wire company to act as the latter's exclusive western agents. This arrangement is a very important one, and one which will lead to a large business. The Cobb wires have been shown by actual tests to be superior in insulating qualities, and have better inductive capacity. This vulcanite insulation will also resist acids and alkalies and any other atmospheric or special chemical action better than any other insulation.

Electrical Patents.

Issued February 12 *and* 19, 1889.

[illegible]. Method of Protecting the Negative Plates of Electrical Batteries. Francis J. Clamer and Joseph G. Hendrickson, Philadelphia, Pa.

The method consists in coating the surface of the negative plates with lead, the lead being prepared by subjecting it to the action of sal ammoniac, arsenic and [illegible] lead.

397,492. Brush for Electric Generators. Rudolph Eickemeyer, Yonkers, N. Y.

[illegible]

"1. In an electric brush, the combination of a [illegible] contact block integ[illegible]

"5. In an electric brush, the combination, with [illegible] piece carbon block in [illegible] of said spring."

[illegible] Battery. [illegible] M. Thompson, Broo[illegible]

[illegible] for Knitting [illegible]

[illegible] H. [illegible]

[illegible]

397,557. Secondary Battery Plate. Edward R. Knowles, Brooklyn, N. Y.

397,594. Electro-magnetic Grain Scale. William A. Holley and Ulrik Malin, Holland, Mich.

397,607. Process of Preparing Electrodes for Secondary Batteries. Leonard Paget, New York, N. Y.

The metallic substance is fused and subjected to the action of a reducing agent, which causes the metallic base to assume the position of a grid, carrying the residual substance in the nature of active material.

397,608. Electrode for Secondary Batteries. Leonard Paget, New York, N. Y.

Claim 1 reads: "An electrode for a secondary or storage battery, in which the active material, or material adapted to become active, and the grid, frame or support merge into each other."

397,613. Regulation of Dynamos. Edwin W. Rice, jr., Lynn, Mass.

Claim 2 is as follows: "The improved bank or battery of dynamos, comprising two or more dynamos having their armatures connected in multiple to the main through exciting coils, equalizing connections between the armature circuits and separate field exciting coils of constant effect supplied in multiple from wires fed by the separate generator."

397,616. Regulating and Motive Device for Alternating Currents. Elihu Thomson, Lynn, Mass.

The invention relates to varying the self-induction or reaction exerted by a coil in an alternating current circuit. The invention is applied either to regulate a current or to vary its amount, or to obtain motion therefrom.

The last claim reads:

"14. The combination with the coil, in one alternating current circuit, of an iron core having a recess or depression to receive the coil, and a second circuit band or conductor encircling said core and adjustable in its inductive relation to the first."

397,650. Secondary Battery. William Kingsland, Gunnersbury, County of Middlesex, England

397,657. Automatic Alarm Apparatus. Emil Meyer, Ottleben, Prussia, Germany.

397,678. Theatrical Appliance. Fred Wilson, New York, N. Y.

397,702. Electric Motor. Julian F. Denison, New Haven, Conn.

397,705. Method of Winding Field Magnets. Thomas A. Edison, Llewellyn Park, N. J.

The claims are: "1. The method of winding a magnet, which consists in placing a cylinder on the magnet core and turning said cylinder to wind the wire thereon.

"2. The method of winding a magnet core, which consists in placing on the core a cylinder made in two halves and turning said cylinder so as to wind the wire thereon."

397,715. Safety Device for Electrical Circuits. William J. Hammer, Boston, Mass.

Two or more fusible safety catches of different conducting capacities are combined with a switching device, so that any one of them may be brought into the circuit of the conductor.

397,729. Automatic Switch for Electric Arc Lamps. Edward R. Knowles, Brooklyn, N. Y.

397,754. Electric Light Carbon. Henry S. Rheiner, Camden, N. J.

The electrode is composed of carbonized cocoanut shell, marl, and an adhesive material.

397,773. Regulating Switch for Electric Motors. Harry H. Blades, Detroit, Mich.

397,790. Electro-magnetic Attachment for Eyeglasses. Frederick Fear, New York, N. Y.

397,796. Storage Battery Plate. Charles D. P. Gibson, New York, N. Y.

The invention, as claimed, consists of a sheet of metal having loops raised from its surface, and active material covering the surface of said plate and extending under the loops.

397,806. Battery for Electric Belts. William G. Johnson, London, England.

397,817. System of Synchronizing Electric Motors. Francis J. Patten, New York, N. Y.

The last claim is appended:

"11. In a synchronizing system for electric motors, a controlling or governing motor, and a series of governed motors at distant stations having four pole armatures excited by a continuous current of one direction and revolving in a single magnetic field, the polarity of which is periodically reversed by changes in the line circuit produced by the controlling motor."

397,8:6. Electric Switch. A. Edwin Andrews, Hartford, Conn.

397,[illegible]. Electric Signaling and Alarm Apparatus. William L. Denio, Rochester, N. Y.

397,[illegible]. Apparatus for Heating Cars by Electricity. Rudolph M. Hunter, Philadelphia, Pa.

397,[illegible]. Overhead Line for Electric Railways. Frank J. Sprague, New York, N. Y.

The main feature of the invention consists in pro[illegible] the overhead line with a downwardly extending [illegible] for receiving the groove of the trolley, and causing [illegible] so that the flange of [illegible] pass onto the frog or switch plate.

[illegible] Electric Lighting System. James A. Galvin, [illegible]

[illegible] Ludwig Gutmann, New York, [illegible]

The element for the core consists of an iron plate provided with two openings which contain the coil, and with a cut or slit which connects the two openings.

397,945. Electric Battery. Elmer A. Sperry, Chicago, Ill.

The carbon elements are suspended under the cover, each by a separate clamp; the carbon elements are placed in a circle about the zinc element.

397,953. Electric Lamp Hanger. Montraville M. Wood, Erie, Pa.

397,965. Electrical Battery. William Burnley, North East, Pa.

Claim 1 follows: "The combination, in an electrical battery, of a permeable sack secured to and suspended from an opening in the jar-cover, with carbons and depolarizing materials inclosed within said permeable sack, and non-conducting material filling and sealing the opening in the jar-cover and the mouth of said sack around the carbons therein."

397,966. Electric Current Indicator. William A. Carey, Malden Mass

A magnet which is energized only at the moment of measuring the current forms the principal feature of the narrow combination set forth in the claim.

397,969. Galvanic Battery. Eben D. Cross, Chicago, Ill.

This is a battery consisting of two cells, combined with a third supplying cell, a fume conducting passage being arranged to conduct the fumes from one of the two cells and discharge the same into the supply cell.

397,977. Telegraphy. Charles E. Dressler, New York, N. Y.

398,025. Insulator. Warren C. Brown Tarrytown N. Y.

398,035. Floating Telegraph Station. Urbain Dieuleveult Tréguier, Cotes-du-Nord, France.

The first claim is given: "A floating telephonic or telegraphic station consisting of a buoy and anchoring-shoe, chains connecting the anchoring-shoe and buoy, distance-pieces connecting the chains with each other at intervals, and a cable passing down through the center of the buoy, the distance-pieces and the anchoring-shoe forming the axis about which these parts may turn without danger of entanglement."

398,045. Apparatus for Bleaching by Electrolysis. Eugene Hermite, Edward J. Paterson and Charles F. Cooper, London, England.

398,069. Safety Gauge. Augustus F. Nagle, Chicago, Ill.

398,075. Secondary Battery. Johannes T. Pederson, New York, N. Y.

The electrode is formed from a strip of lead, bent upon itself so as to form a series of flattened horizontal convolutions, and having pockets pressed into the surface of the strip to contain the active material, and having grooves or openings through which access is obtained to the active element.

398,101. Process of Purifying Sewage by Electricity. William Webster jr., Lee Park, Lee, County of Kent, England.

398,121. Equalizer for Electric Currents. Sigmund Bergmann, New York, N. Y.

The first claim is as follows: "In an equalizer for electric currents, the combination, with the coils, of the metal frame comprising the uprights having the threaded ends, the end castings or plates having threaded openings engaging the uprights, and the insulators in said end castings or plates."

398,122. Static-Induction Generator. Edward T. Birdsall, New York, N. Y.

398,132. Galvanic Battery. Eben D. Cross, Chicago, Ill.

The negative electrode is combined with a solution of nitric acid and nitrate of ammonium.

398,133. Electric Belt. Samuel De Baun, Kansas City, Mo.

398,144. Door spring Connection for Electric Burglar Alarms. John Geary, Philadelphia, Pa.

398,194. Secondary Battery. Illius A. Timmis, 2 Great George street, Westminster, County of Middlesex, England.

The element consists of a plate composed of litharge and a solution of sulphate of ammonia.

398,222. Railway Car. John A. Brill, Philadelphia, Pa.

398,272. Element for Thermo-Electric Batteries. Max Mestern, Turin, Italy.

Claim 1 reads: "An element for thermo electric batteries, comprising a positive and negative electrode in contact with each other, a metallic inclosing casing of greater refractory power than that of the electrodes, and a fireproof non-conductive lining arranged to isolate one of said electrodes from the casing."

398,288. Switch for Electric Circuits. Clarence C. Stirling, Hartford, Conn.

398,294. Cable Railway System. Charles J. Van Depoele, Lynn, Mass.

398,314. Stop Mechanism for Steam Engines. Herbert L. Currier, Lynn, Mass.

398,327. Electric Spray-Producing Apparatus. Hilarion A. B. Huguet de Vars, Paris, France.

10,986. Electric Discharge Device. Reginald Belfield, Pittsburgh, Pa

The invention relates to the class of devices employed for securing a silent and harmless discharge of electric currents of very high tension, and the claims are as follows: "1. The combination, with a driving-engine, of an electric generator, a belt connecting the generator with the engine, and discharge points directed toward the pulley or belt wheel of the generator and an electrical connection with the engine.

"2. The combination, with an alternate current electric generator, of discharge points insulated therefrom and directed toward the belt wheel of the generator."

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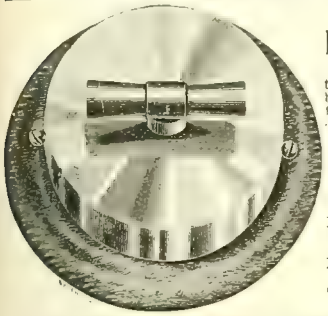

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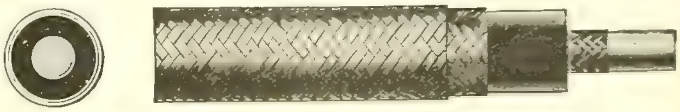

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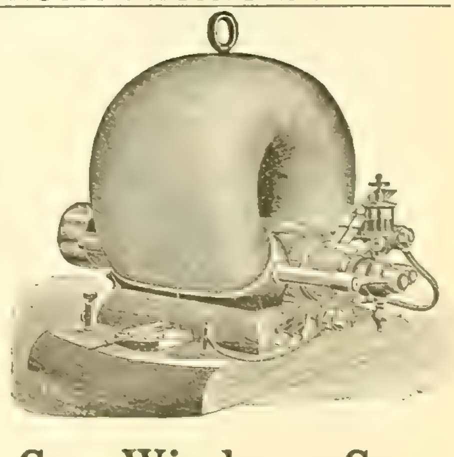

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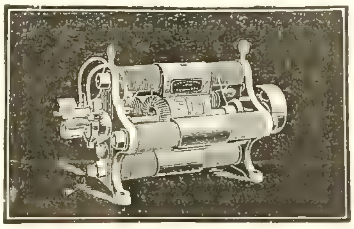

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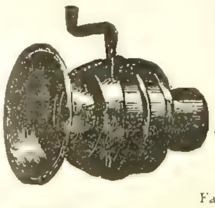

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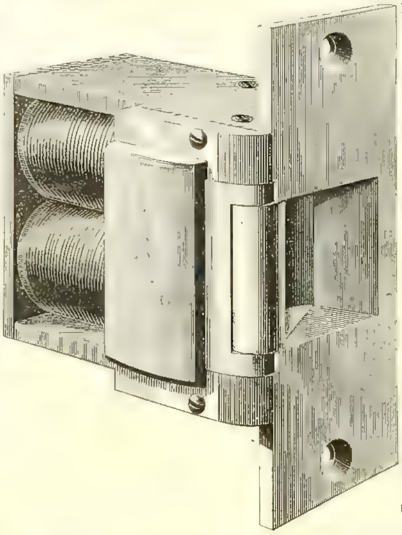

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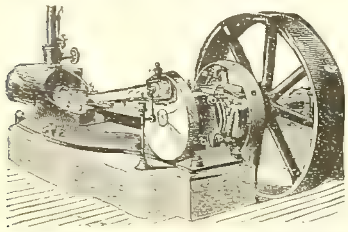

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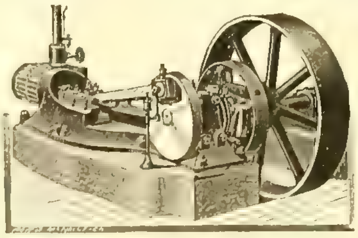

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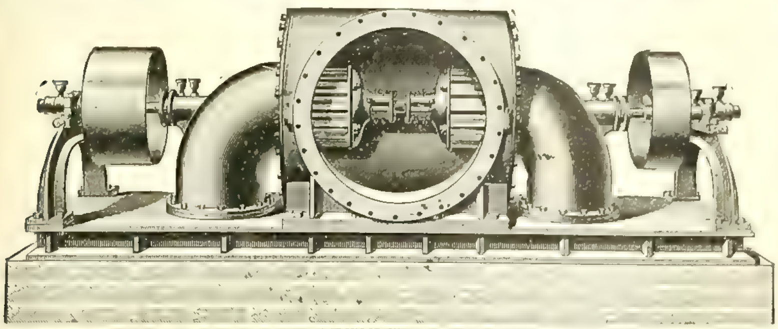

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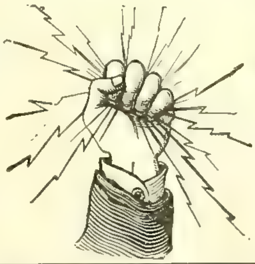

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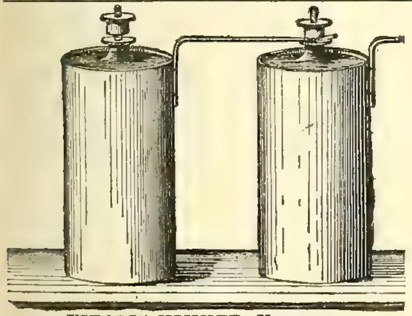

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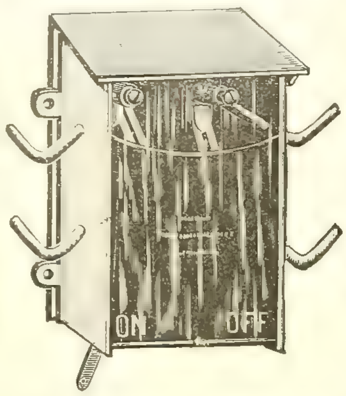

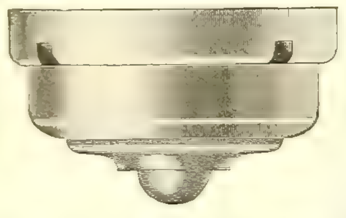

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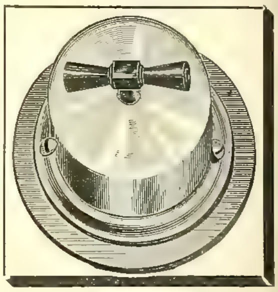

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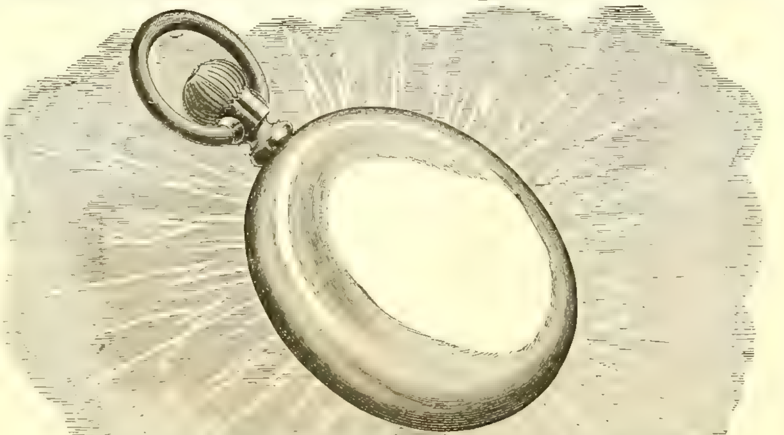

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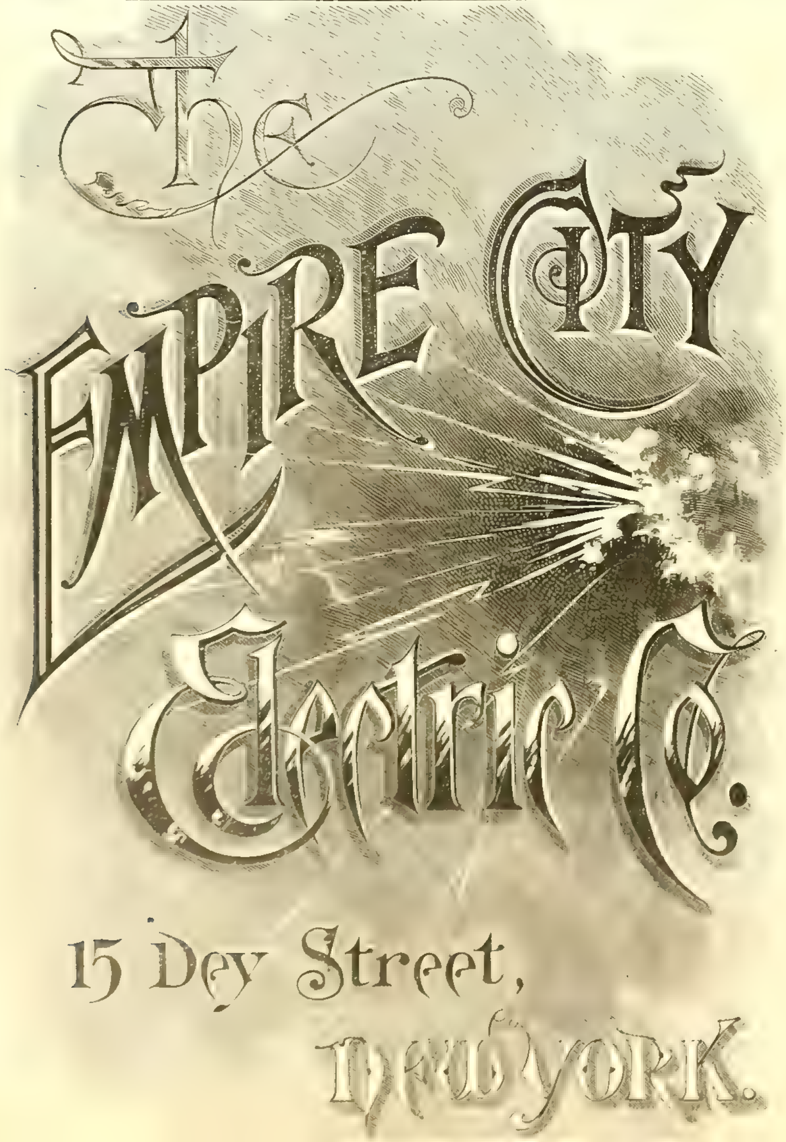

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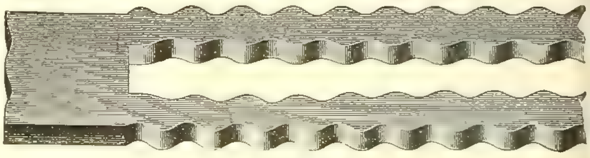

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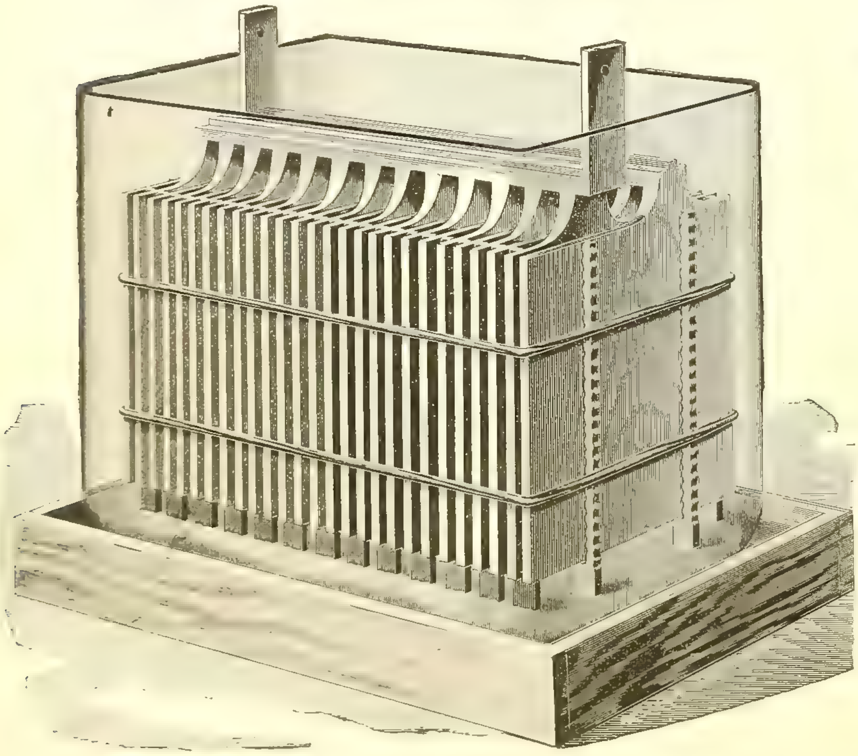

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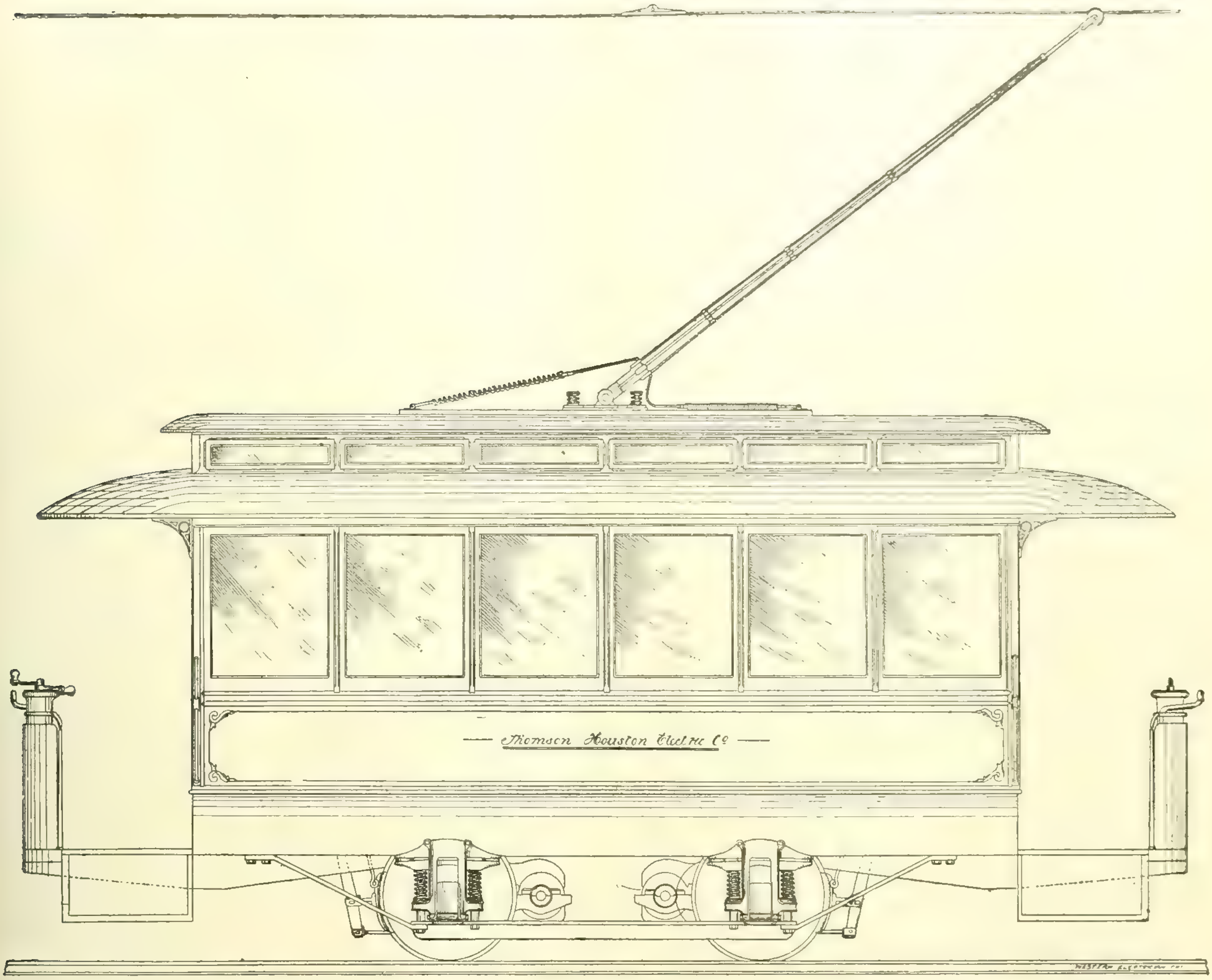

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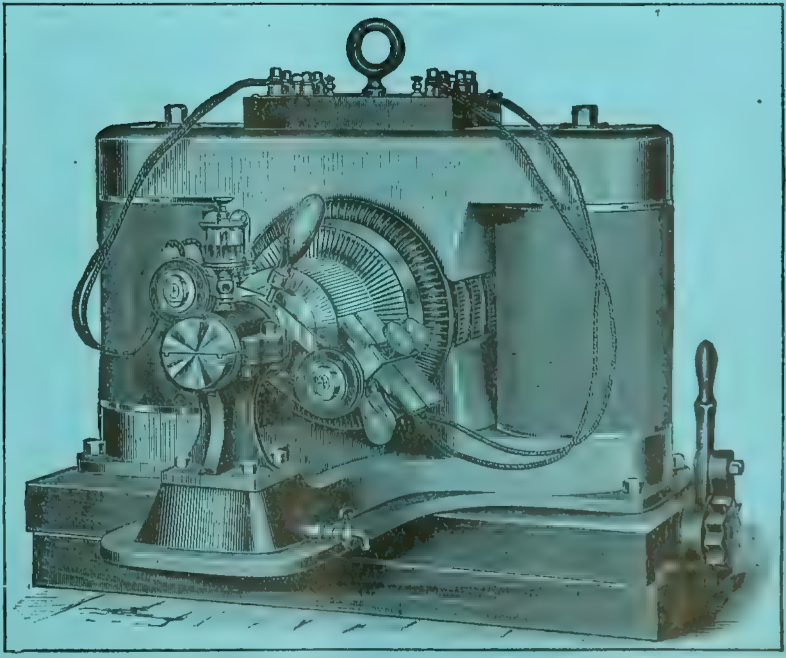

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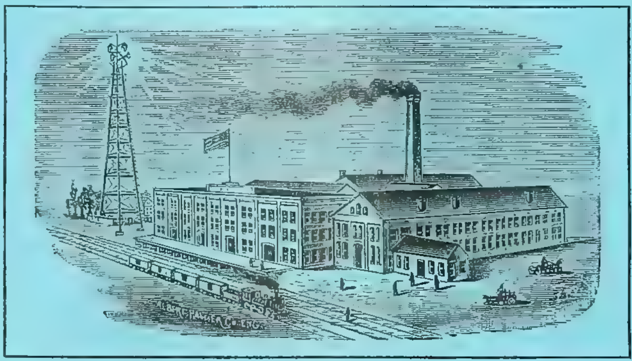

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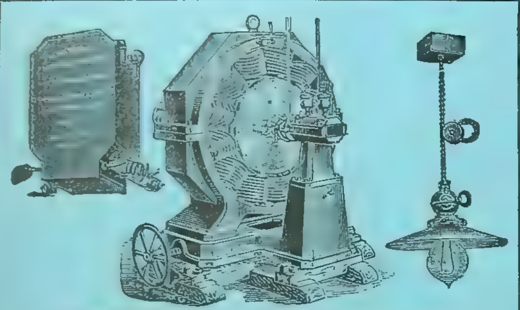

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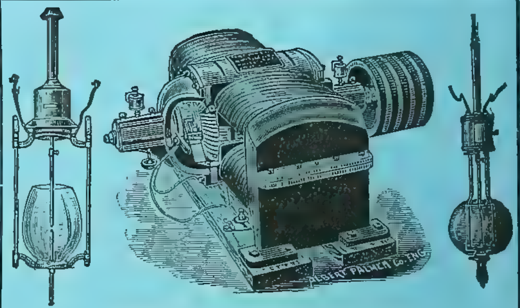

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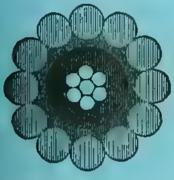

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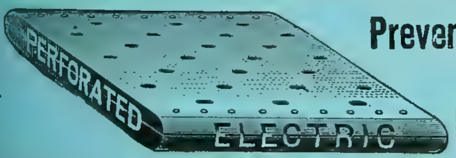

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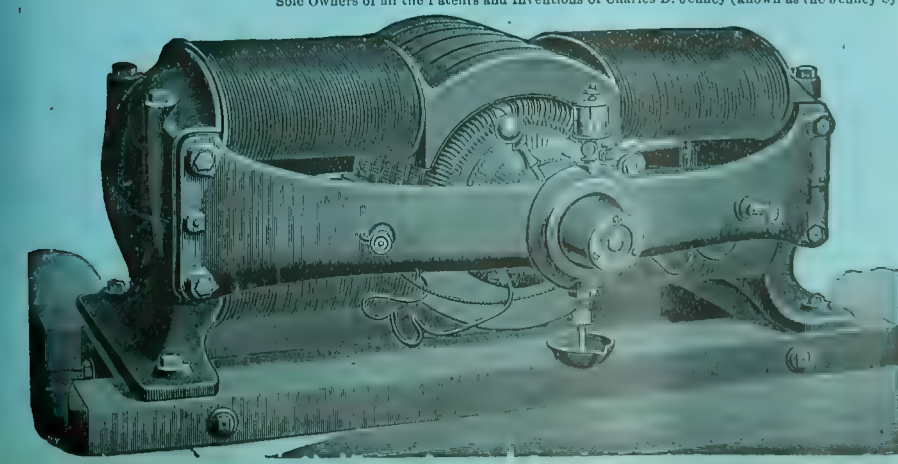

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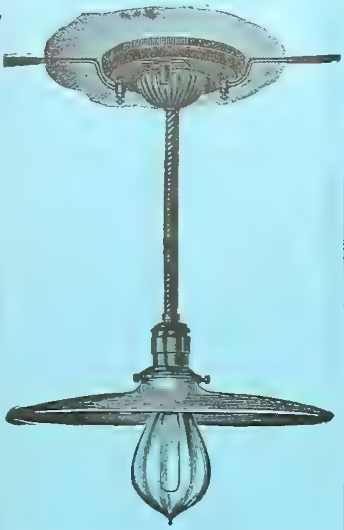

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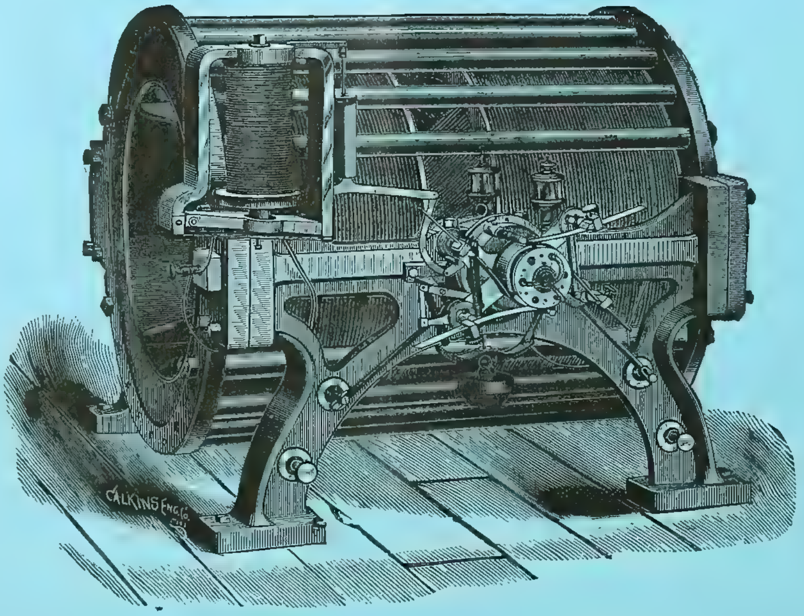

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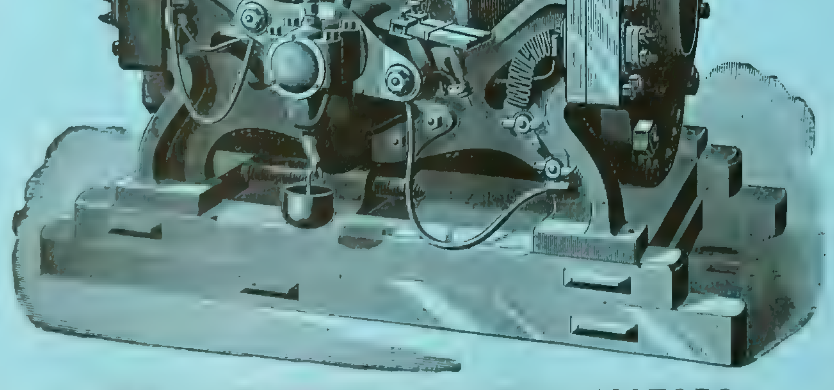

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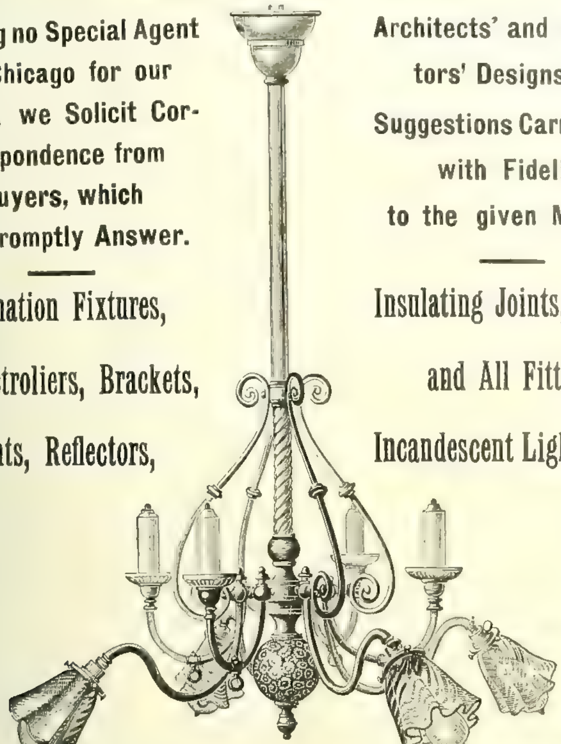

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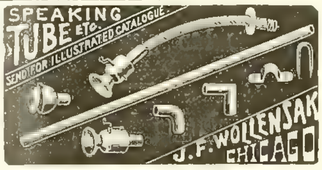

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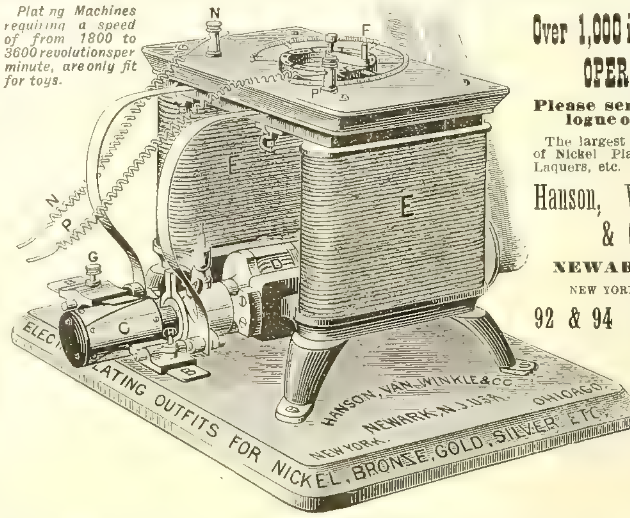

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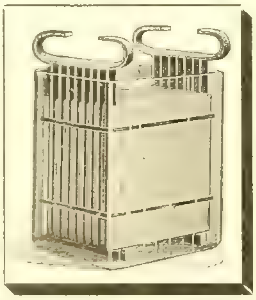

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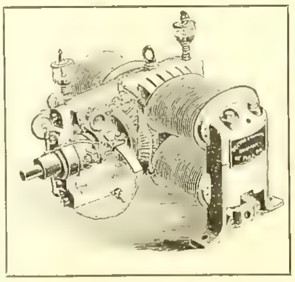

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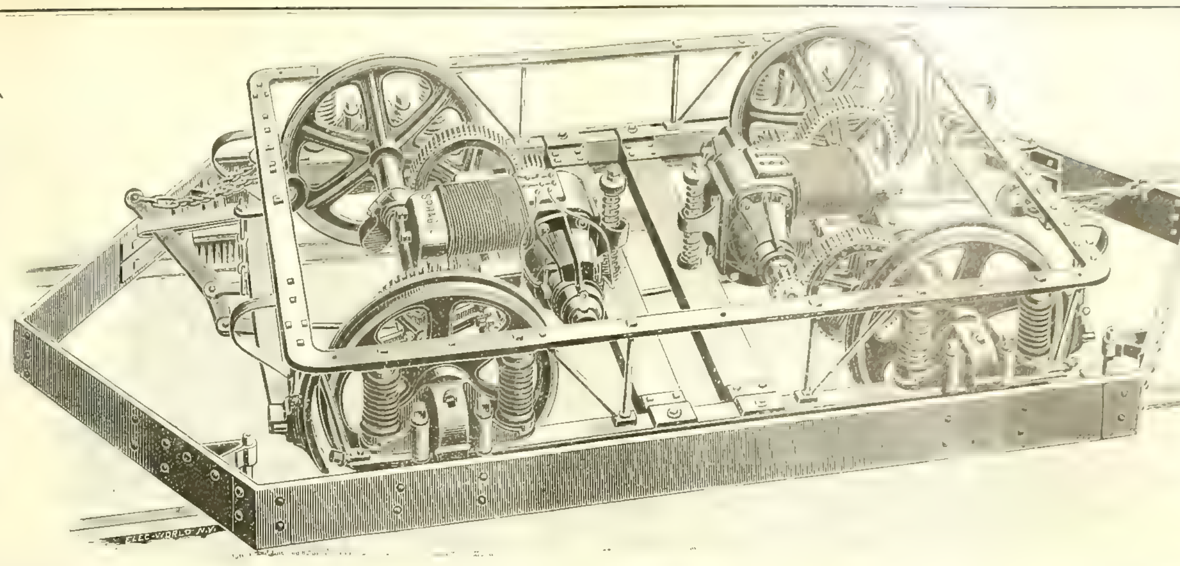

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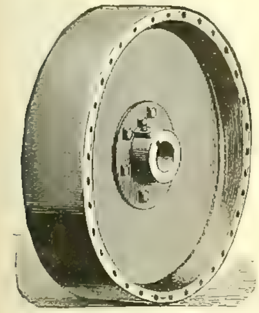

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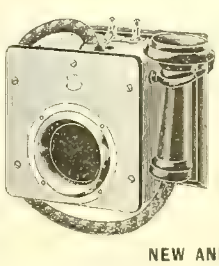

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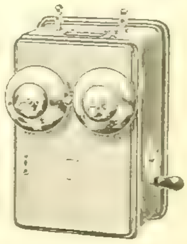

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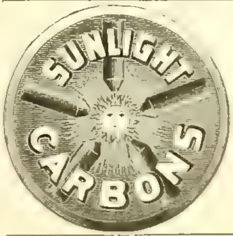

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Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

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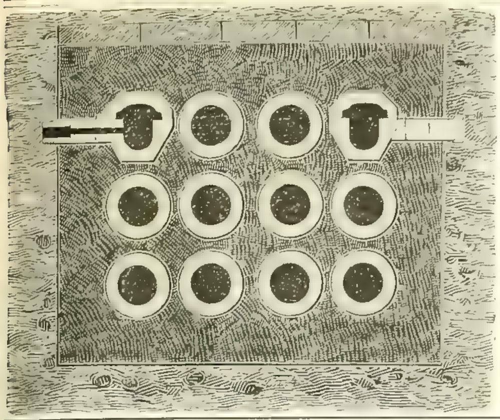

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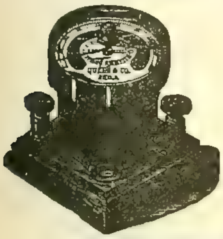

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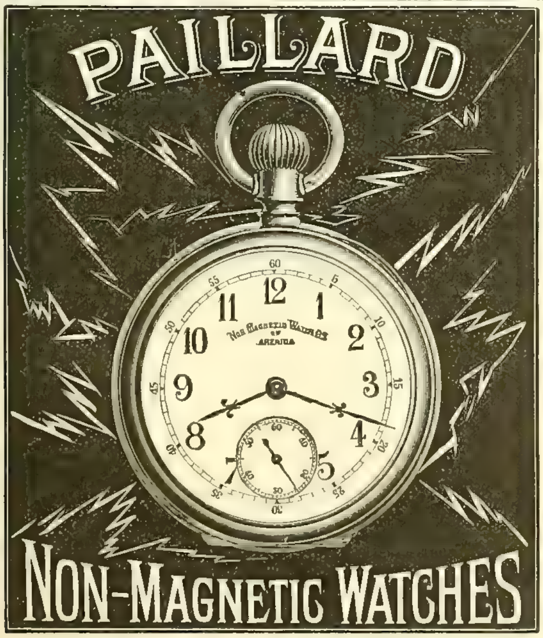

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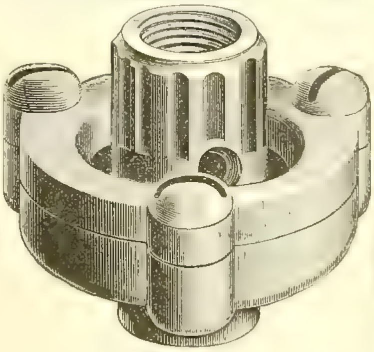

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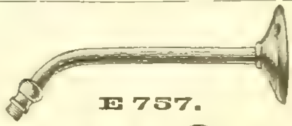

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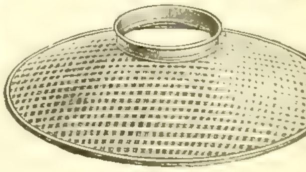

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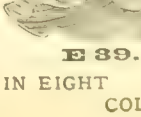

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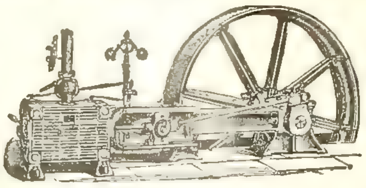

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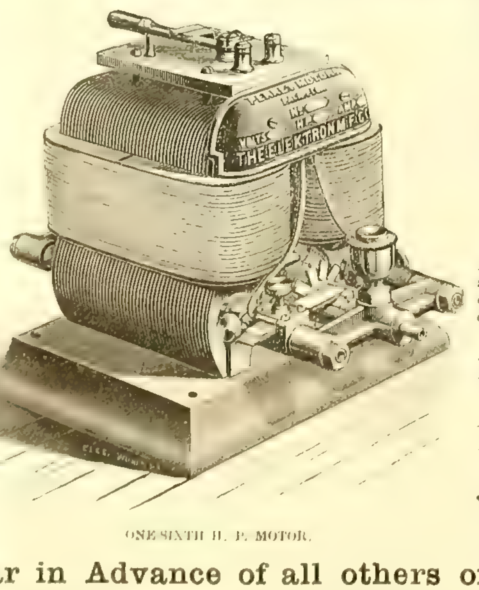

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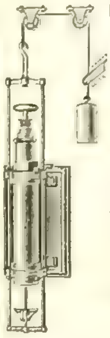

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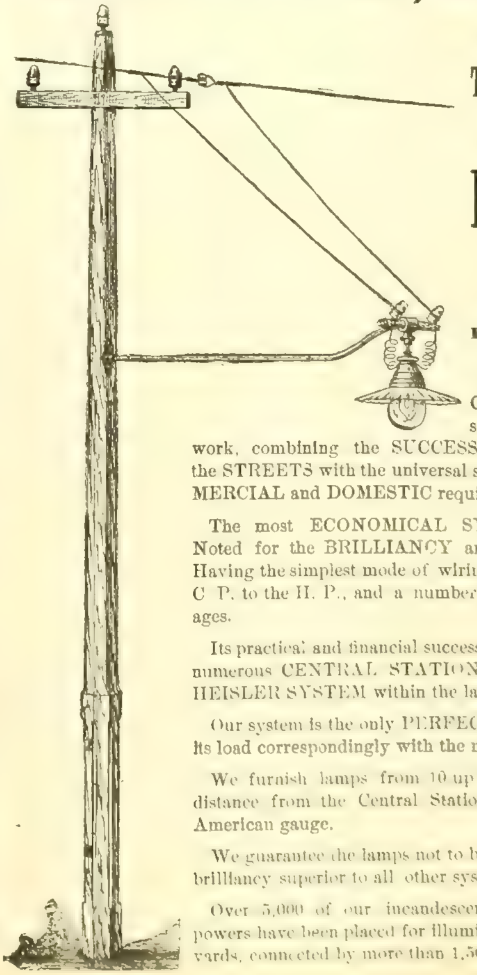

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Over 5,000 of our incandescent lamps of various candle powers have been placed for illuminating the streets and boulevards, connected by more than 1,500 miles of line wire circuits

THE

WESTINGHOUSE ELECTRIC CO.,

PITTSBURGH, PA.

THE PIONEERS IN INCANDESCENT LIGHTING

BY

ALTERNATING CURRENTS

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COMPLETE CENTRAL STATION OUTFITS.

Alternating Current Apparatus,

Direct Current Apparatus,

Arc Lighting Apparatus,

Electric Motors,

Electric Meters.

150 CENTRAL STATIONS IN OPERATION. 150

OFFICES IN ALL LEADING CITIES.

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—LESSEES OF—

THE UNITED STATES ELECTRIC LIGHTING CO.

Sales Department, 120 Broadway, NEW YORK.

Arc and Incandescent Apparatus

—FOR—

ISOLATED LIGHTING.

Efficient Apparatus!

Economical Lamps!

Ingenious Devices!

THE SAWYER-MAN ELECTRIC CO.,

510 West 23d Street, NEW YORK.

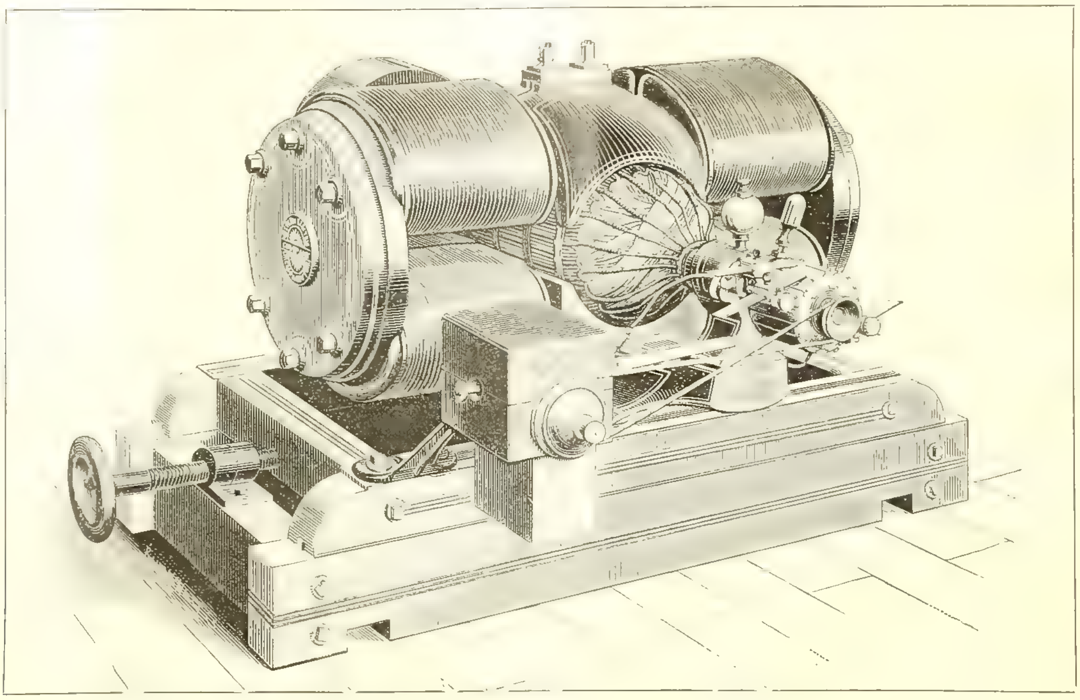
Incandescent Electric Lamps

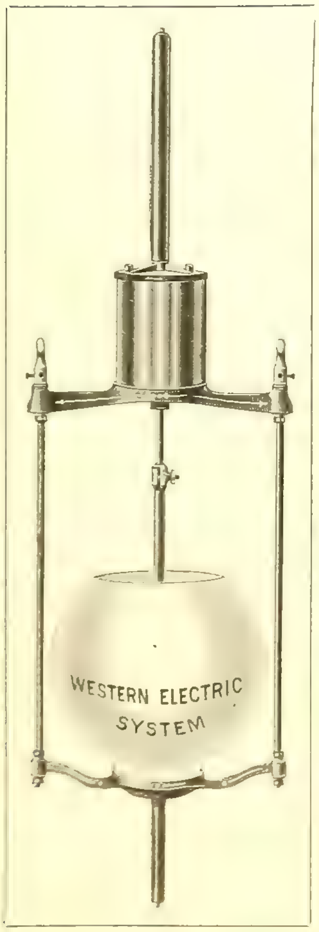
—AND—

SUPPLIES FOR ELECTRIC WORK.

ELECTRIC AND COMBINATION FIXTURES.

CORRESPONDENCE WITH DEALERS INVITED.



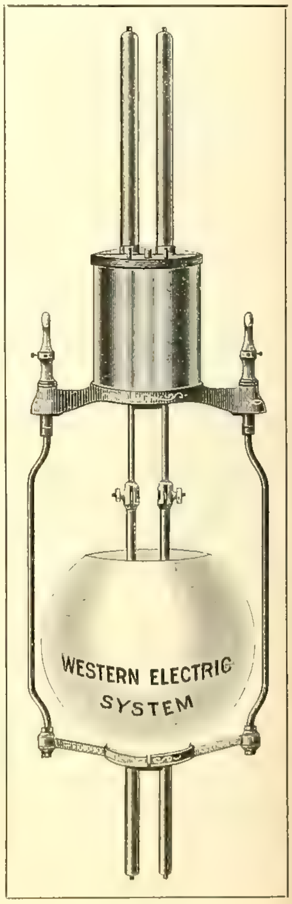


HIGH AND LOW TENSION SYSTEM

OF

Arc Lighting.

COMPLETE IN EVERY RESPECT.



PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

Vol. IV. CHICAGO, MARCH 9, 1889. No. 10

The Sperry Regulator.

Among the patents dated February 26th was one issued to Elmer A. Sperry, of Chicago, relating to a regulator for dynamo electric machines. The invention is one which has excited considerable interest, as the greatest efficiency has been claimed for the device. Heretofore the regulator has never been illustrated, and it has never been fully described. The cuts which are herewith presented and the descriptive matter are taken from the patent specification.

Fig. 1 is an end view of a dynamo with the regulator attached. Assuming that the parts are in the position indicated in this cut and the line resistance permanent, the magnetization of the field magnet will be constant, and the vibrator or magnetic mass K^2 will be held at a practically uniform distance from the adjacent field magnet. If the resistance be suddenly diminished—as, for instance, by the extinguishment of some of the lamps on the main line—and it is desired that the current-collector should rotate over toward the position shown in dotted lines, this motion can be accomplished by the retraction of the bars J and J' and the spring-connection J^2. This change will only take place when the lower dog, G^{11}, is held against its adjacent ratchet bar, and in that event the reciprocations of the block G^7 will cause the dog to feed the bar J, together with the bars J' and J^2, toward the left in the cut, thus carrying the current-collector about toward the position indicated in the dotted lines; but this action only takes place when the arm K^{11} bears upward against the dog G^{11} sufficiently to overcome the downward tendency of the spring L^4. This motion the arm K' will have when the vibrator or magnetic mass K^2 is drawn with sufficient force toward the field magnet C. The field magnet C will draw this vibrator or magnetic mass to itself proportionately to the increase of magnetism in the field magnet C, so long as the same is unaffected by the currents in the armature, and this increase takes place as the resistance in the line is diminished by the extinguishment of lamps or by other causes. The vibrator or magnetic mass K^2 is drawn closer to its magnet C, the arm K^{11} forces the dog G^{11} into engagement with its ratchet, and the bars J, J' and J^2 are moved step by step toward the left in the cut to rotate the current-collector toward the position indicated in the dotted lines. This operation continues until the current-collector has reached a position where the current is again normal. It is found that as the current-collector moves toward the position indicated in the dotted lines the position of the neutral point of the armature so changes with reference to the field magnet C, adjacent to the vibrator or magnetic mass K^2, that the resultant of the magnetism of the field magnet C and the currents in the armature, which resultant affects the vibrator or magnetic mass, cannot sufficiently affect the vibrator or magnetic mass K^2, and the compensating motor is employed which is operated by cam J^4, so located on the bar J' that as the neutral point approaches such described position the roller or trunnion L^3 travels along such cam J^4, and by means of the spring or motor L' and arm L assists in holding the vibrator or magnetic mass K^2 toward its field magnet. Generally the variation of the assistance during the greater part of this movement is not great; but as the collector nearly approaches the position indicated and the described resultant rapidly loses its power to affect the vibrator or magnetic mass K^2 the curved or parabolic portion of the cam J^4 receives the trunnion L^3, rapidly swings the elbow-lever L^2, and thus increases the power of the compensating motor or spring to force the vibrator or magnetic mass into that position which it must occupy to continue the excursion of the bar J toward the left, and which position the magnetism of the field magnet or the currents of the armature, or the resultant of the magnetism and the currents of the armature are powerless to make it assume, and which position it must occupy to maintain the normal current in the exterior circuit traversed by the perfected or generated current.

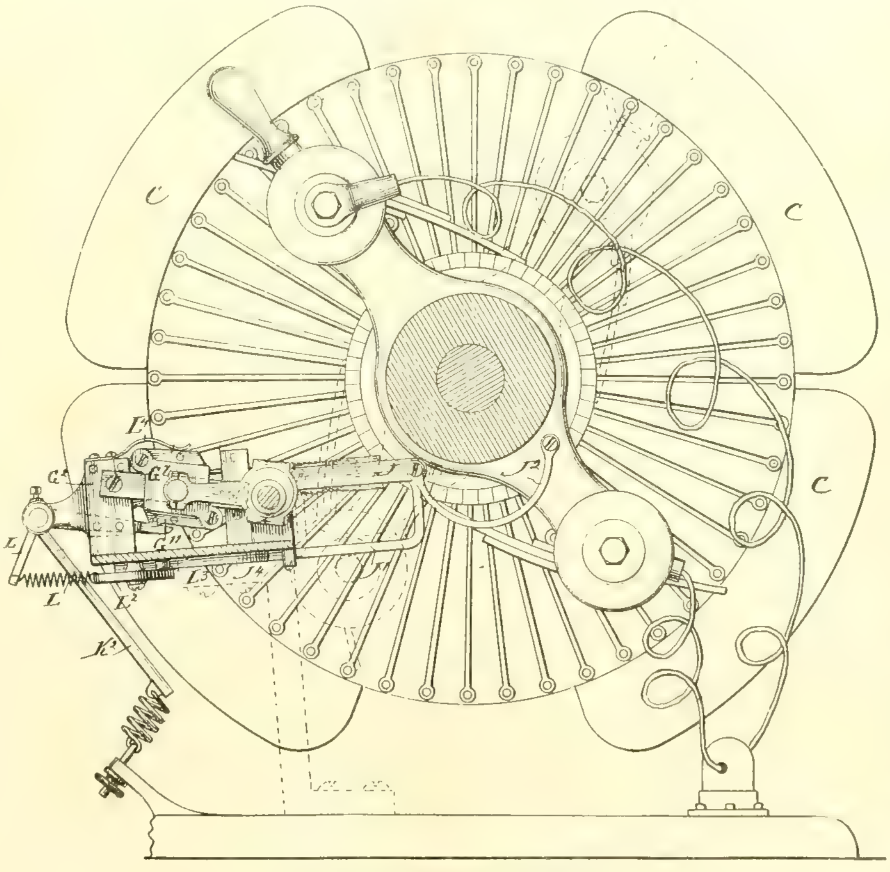


FIG. 1. THE SPERRY REGULATOR.

The spiral spring, which is connected with [illegible] mass [illegible] regulates [illegible] tor. Of course many other kinds of motors [illegible] sist the action of the magnetic mass in compensation for its change of power incident to the variation in the magnetization of the field magnet at the point near which such magnetic mass is placed, or, in other words, to the variation of the resultant of the magnetization of the field magnet and the currents in the armature.

The shifting device or shifter for the movable current-collector consists, substantially, of the reciprocating bar, though of course other shifters might be used. This bar is called the "shifter."

The block and pitman which are driven from the shaft of the dynamo are termed the "driving motor," since they co-operate to reciprocate the shifter.

In the form of device shown, the operation of the magnetic mass, aided at certain parts of the excursion of the shifter by the reinforcing motor, which is controlled and set in operation by the cam, is primarily to apply the driving motor to the shifter in such manner as to secure the proper motion of the shifter.

The object is to transmit the force or power existing in the place where such mass is located into motion or power to be applied directly or indirectly to shifting the current-collectors or to connect the driving motor with a device to shift such collectors. When the magnetic mass is located as shown, and the lamps are being turned on, the action of a compensating motor is to gradually decrease the action which it exercises toward such mass. It might be possible to so place the magnetic mass as that this action would be reversed and the power of the magnetic mass would be in the first instance too great, and would require a diminishing resisting influence from the motor instead of an increasing aiding influence, as in the form herein described. In either case the result would be the same, namely, the compensation by such motor for the inequality of influence exercised over the magnetic mass by the field magnet. The varying heights at which the dogs are held with respect to the ratchets by the lever K' permits them to skip a greater or less number of ratchet teeth in successive excursions, and thus to engage the ratchets at varying points along the [illegible]. Thus each successive excursion of the dogs may cause the ratchets to travel unequal distances, owing to the angular arrangement of such ratchet bar with reference to the travel of the dogs.

Fig. 2 is a side view of a portion of the driving

mechanism. Fig. [illegible] view of the driving mechanism. Fig. [illegible] of the reinforcing mechanism.

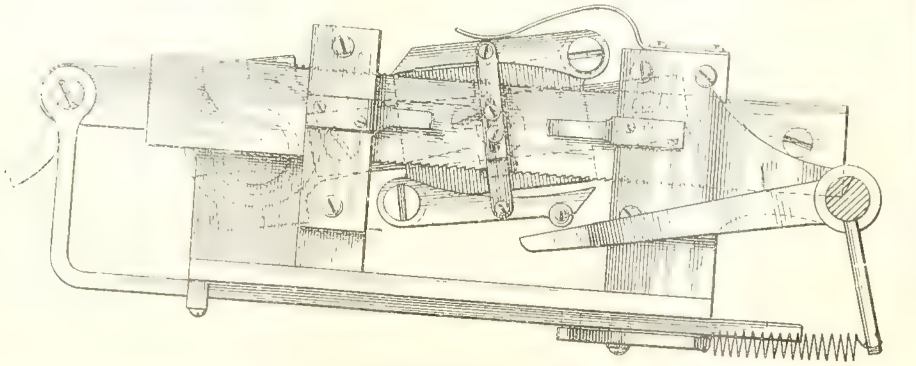


FIG. 2.—THE SPERRY REGULATOR.

[illegible] claims are allowed for the invention. Among the number are the following:

"1. In a current-regulator for dynamo-electric machines, the combination of a vibrating magnetic mass in proximity to the field magnet with a movable current-collector and an elastic connection between the two.

"14. In a current regulator for dynamo-electric machines, the combination of a movable current collector with a shifter therefor, the two connected by an elastic connection, and a driving motor for such shifter.

"31. In a current regulator for dynamo-electric machines, the combination of a movable current collector, a shifter therefor, a driving motor for said shifter, connecting parts between the shifter and motor and attached to one and adapted to engage the other at varying intervals, a magnetic mass in proximity to the field magnet, and connections therefrom to the motor to control its application to the shifter."

THE Medico-Legal Society of Chicago has been considering the subject of electric executions. The discussion indicated that the members generally did not favor a change from the method usually employed. They thought that hanging was no more painful than "electrolethe." One of the physicians advocated a method by which criminals would be obliged to imitate the example of Socrates, and partake of the poisonous cup.

Fort Wayne Jenney Company

A dispatch from Fort Wayne, Ind., says: The location of the Fort Wayne Jenney Electric Light company's shops, which has been a matter of speculation since the destruction by fire of the buildings three months since, has been definitely settled, and in favor of Fort Wayne. There has been a lively bidding between Brooklyn, N. Y., [illegible], Ill., Grand Crossing, Ill., Fremont, O., [illegible] places. It was agreed that if $30,000 [illegible] in sight. [illegible]

St. Louis Electric Light Contract.

The board of public improvements of the city of St. Louis invited, some time ago, bids for electric lighting. These bids were opened February 28th, at 12 o'clock. In the appended

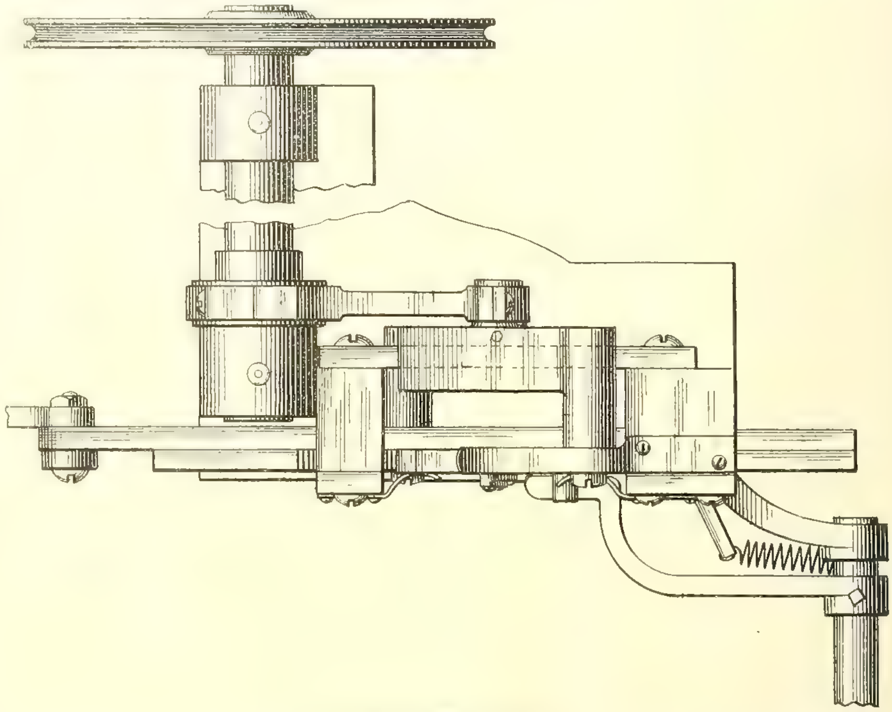
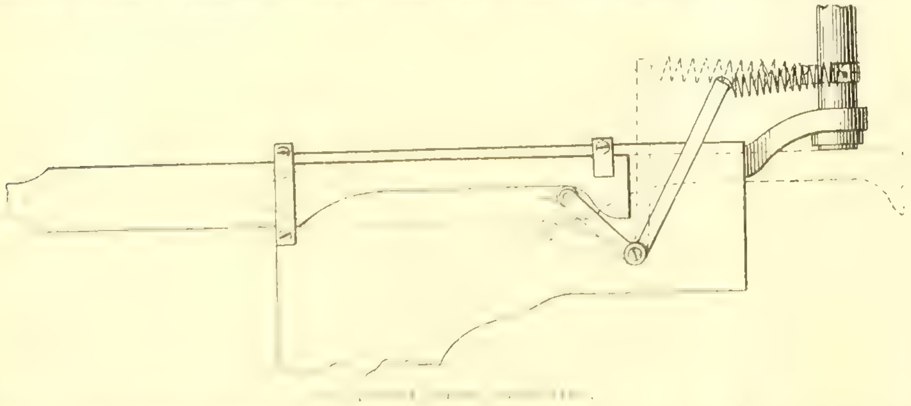


FIG. 3.—THE SPERRY REGULATOR.

table the proposals are summarized. The following items from the specifications will explain the figures given in the table:

HOURS AND SEASONS OF LIGHTING.

The hours and seasons of lighting shall be: *a*. Street and alley lighting shall be from forty-five minutes after sunset until thirty minutes before sunrise, every day in the year. Thoroughfares through parks shall be lighted as streets. *b*. Park lighting shall be from forty-five minutes after sunset until midnight, beginning the 1st day of May, [illegible] of October of each year [illegible] shall be rated as of two classes [illegible] some light may be needed [illegible] Lights in other [illegible] o'clock [illegible] September 30th and [illegible] midnight, from [illegible] These lights may be cut off [illegible]



[illegible]

ADDITIONAL LIGHTS.

Any street, public place, park or building, which shall not have been previously lighted shall, upon requisition as above provided, be lighted from and after thirty days after notice of such requirement is given the contractor.

LOCATION OF LAMPS.

As a general rule arc lights for street lighting will be placed at alternate street intersections, so that the field of illumination for each lamp will extend one block in every direction, if blocks be less than 400 feet in length. if the blocks be more than 400 and less than 800 feet in length. a lamp will be placed at each intersection; and if the blocks are over 800 feet in length, an intermediate lamp will be placed at or near the middle of the block. Along suburban roads lamps will be approximately 1,000 feet apart. If the municipal assembly, by ordinance, should require the lighting of alleys, lamps will be placed near the middle of the blocks; such lamps may be incandescent lamps of 30 candle power each.

SUPPORTS OF LAMPS.

The poles for carrying street lamps and the means of suspension must not be dangerous, unsightly, or such as to incommode the adjoining property unnecessarily. The material, design and color of such poles or supports must be approved by the board of public improvements.

It would require to meet the specifications about 1,600 2,000 candle power arc lights and

	Thomson-Houston Electric Co.	La Clede Gas Light Co.	C. A. Brown (Western Electric System.)	Missouri Electric Light & Power Co. (Westinghouse System.)	Chas. Sutter (Indianapolis Jenney System.)	Average.
Arc lamps [illegible] for street lighting, each [illegible]	$115 00	$109 50	$[illegible]	$94 75	$74 5[illegible]	$98 64
Arc lamps [illegible] for park lighting, each [illegible]	4[illegible] 00	40 00	[illegible]	2[illegible] 00	3[illegible]	47 59
Arc lamps [illegible] for public building lighting, rated as Class [illegible] specifications, each per annum	210 00	21[illegible] 00	1[illegible]6 66	94 75	51 25	146 52
Arc lamps [illegible] for public building lighting, rated as Class [illegible] specifications, each per annum	75 00	76 32	54 00	......	......	70 [illegible]8
Incandescent lamps of [illegible] c. p. for street lighting, each per annum	24 00	1[illegible] 95	17 50	26 00	26 20	22 33
Incandescent lamps of [illegible] c. p. for park lighting, each per annum	9 00	5 00	3 37	20 00	17 00	10 27
Incandescent lamps of 16 c. p. for public building lighting, rated as Class 1 of specifications, each per annum	30 00	27 00	20 00	9 50	14 90	20 28
Incandescent lamps of [illegible] c. p. for public building lighting, rated as Class [illegible] of specifications, each per annum	[illegible] 00	8 75	[illegible] 02	7 00	13 00	8 75

The [illegible] Electric Light Company's bid was rejected because it did not comply with the specifications.

2,000 30 candle power, and 3,000 16 candle power incandescent lamps. The specifications permit the substitution of 30 candle power incandescent lamps for some or all of the arc lights used for street lighting. By the terms of the specifications bids for arc lights for illuminating public buildings instead of incandescent lights were allowed.

The bids include cleaning, maintaining, repairing and operating expenses during the term of ten years, beginning January 1st next. From the data it will be seen that it is difficult to determine whose bid is lowest on the entire work. The determination will depend on the action of the board; that is to say, the board must first

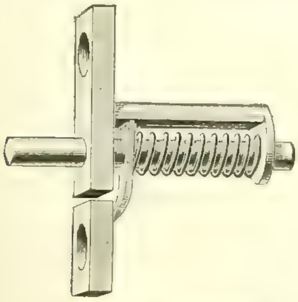


FIG. 1. TURNQUIST DOOR SPRING.

decide how many arc lights, 30 candle power incandescent lights and 16 candle power lamps shall be used.

The final award of the contract will depend not only upon the figures, but also upon the responsibility of the bidders and the superiority of the system to be installed. It can very easily be calculated that it will cost at least $425,000 to erect the lighting plant.

The St. Louis *Republic* says, in reference to the substitution of electric light for gas: "The city now pays the gas companies every year about $280,000 for furnishing the street illuminant, and about $50,000 for lighting public buildings. The parks under the new system will be well lighted, the streets much better lighted, also the public buildings, and in addition to these points in favor of the new system there is one other of very great importance. The electric lights will be turned on soon after sundown,

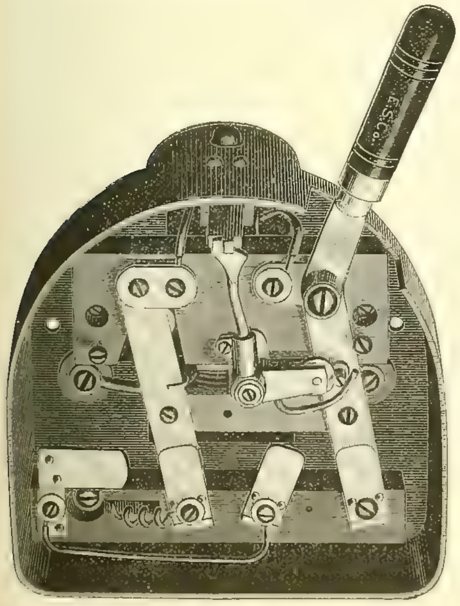


FIG. 2. AUTOMATIC GROUND SWITCH.

and be kept burning until broad daylight, and this every night in the year, both winter and summer, while now, on moonlight nights, or nights put down in the calendar as moonlight nights, the streets are in absolute darkness so far as gas lights go, even though the night prove cloudy. The committee will decide within the next day or two on the bid or bids most advantageous to the city, and the contract will then go to the city council for ratification and approval. There seems to be little doubt that the 1st of January next will see the city of St. Louis lighted successfully by electricity."

Electrical Novelties.

The accompanying cuts illustrate several novelties recently put on the market by the Electrical Supply company, of Chicago. Fig. 1 shows the Turnquist door spring. Many springs have been designed for the closing of the electrical circuit when the door is opened, but nearly all have serious objections. A large part of the door jamb has to be removed, or a large aperture made to contain the working parts. The springs have within themselves an insulating medium, which is liable to shrink and deteriorate, permitting constant leakage and false alarms. The Turnquist spring has no insulating substance entering into its make up, and requires but the boring of a half-inch hole in the door jamb for its insertion. The contact is separated by a slight distance, the jamb itself performing the function of insulation. A sliding contact is obtained, which is very valuable for keeping the surface bright.

Fig. 2 shows the latest construction of the automatic ground switch. A full description of the old form of this switch has been given in the WESTERN ELECTRICIAN, but the construction has been changed. One of the switch arms has been extended for the fastening of the handle. The automatic releasing device will cause the switch to operate when a ground occurs which would be sufficient to jeopardize life or property. A slight or extremely high resistance ground will not operate the switch. It is, therefore, not unduly sensitive, and will not operate without sufficient cause. It can be operated as an ordinary double-pole hand switch by the pushing of

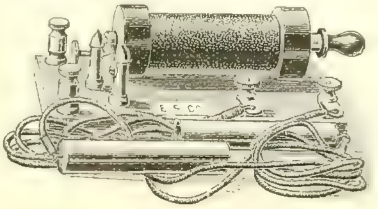


FIG. 5. MEDICAL COIL.

a button which projects slightly from the lower part of the switch. Its action is instantaneous, and throughout is well designed.

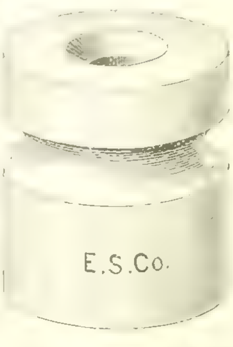
The new lava insulators are illustrated in Figs. 3 and 4. The appreciation and utilization of lava as an insulator have been growing for the past two years. Electrical manufacturers have not been slow in adopting an insulator which is perfectly non-combustible, and at the same time is almost entirely free from changes due to moisture.

Fig. 5 illustrates the Electrical Supply company's new medical faradic coil. It is durably constructed, neat in appearance, and perfect in operation. While in action the power of the current is under perfect control. Cords and terminals are furnished, forming a part of the outfit, by means of which the electrodes can be taken at some distance from the apparatus. The proportions have been worked down with great care, so that with a given battery strength the greatest faradic effects are produced.

Underground Wires.

In conversation with a representative of the WESTERN ELECTRICIAN recently, Professor Barrett said: "During a recent trip to New York I had an opportunity to see what was being done in the way of burying wires in the east. The subway commission of New York means business, I think, and Mayor Grant seems to be after the electric companies that are opposed to the underground system. They have fine conduits in New York city—they're models—and I wish I had a few miles of them out here. Much interest is manifested in New York in the work that has been done in Chicago in the way of burying wires. I told them there, as I have often told electricians elsewhere, that I do not represent any company, clique or system, but the community at large, and I know the people want underground wires. A corporation that opposes public sentiment in this matter is merely cutting its throat. It's a short-sighted policy, and I am surprised more of the companies don't view it in that light.

"Of course there are many points to be considered in this matter, and the first, that of the [illegible] ing the effect in a large city, it is different. [illegible]



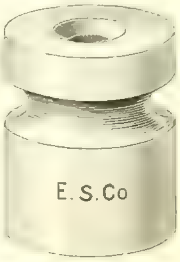


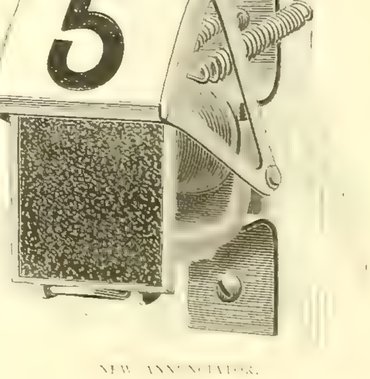
FIG. 3. LAVA INSULATORS. FIG. 4.

telegraph poles, with hundreds of wires strung upon them, is positively an obstruction, and a great public nuisance. That is all there is to it.

"Here in Chicago the underground system has been given a trial; it has proven satisfactory, and that is the best argument I can offer. When people come to me from other cities and ask me for advice on this topic, I say: You see what we have done here. We have buried the wires, and we would not, under any consideration, return to the old system. It often hurts the companies interested, but what else can I say without stultifying myself? I have advised the people of Chicago to bury the wires, and acting on my advice they have done so. The experiment has proven successful. These are facts, and facts that cannot be overcome."

A New Annunciator.

The accompanying cut represents a new electric annunciator, introduced by Edwards & Co. of New York city. The following special claims are made for the new device: Compactness, simplicity of construction, a positive lock until released by the magnet, and so arranged that it will discharge any residual magnetism every



NEW ANNUNCIATOR.

time the tag drops, so that the armature cannot stick. The raising arrangement is so constructed that it will only interfere with the drops that are down, thereby avoiding the strain that would otherwise ensue.

The reports that the storage battery car in Sacramento had been taken off the road are incorrect. The car has been running satisfactorily, having made since starting some 3,000 miles, and will continue to run. No new cars will be added, however, until the Pacific Storage company has completed its factory and is able to make the batteries on the Pacific coast.

The Thomson-Houston Electric Railway at Des Moines.

[illegible] Des Moines, Iowa, which was equipped by the Thomson-Houston [illegible] has been in operation since Dec. 20, 1888. This line is seven and one-half miles in length, and at present there are eight cars in daily operation, each equipped with two 10 horse power Thomson-Houston motors. The road is double track, and overhead construction has been used throughout.

The power plant consists of a 100 horse power engine and boiler, and a Thomson-Houston 80 horse power generator. The operation of this road during some severe weather has done much to dissipate the doubt regarding the feasibility of running electric cars during snowstorms. About December 28th a severe snowstorm visited Des Moines, about one foot of snow falling. Of the three tramway lines in Des Moines—steam, horse and electric—the electric railway was the only one to operate on schedule time, making regular trips every fifteen minutes, a fact which [illegible]inly is very flattering to the system.

THOMSON-HOUSTON ELECTRIC RAILWAY AT DES MOINES.

New Brush for Railway Motors.

[illegible] Thomson-Houston Electric company has recently substituted in its railway motor service [illegible] brushes for copper brushes. The copper brushes heretofore used allow the armature to rotate in either direction with perfect freedom, [illegible] maintained at an even pressure [illegible] They have always pro[illegible] experiment made [illegible] the belief that it [illegible] superiority over the copper, which supposition has since been found to be [illegible] general [illegible] Thomson-Houston [illegible]

[illegible] concerning the wearing of this brush [illegible] very [illegible] and grades, and [illegible] state without excep[illegible]

[illegible]

Investigating the Underground System.

The Boston officials who visited Chicago recently to inspect the electric light plant were courteously entertained by City Electrician Barrett, who gave them all the assistance in his power in their investigations. The electric light companies of Boston and many city officials oppose burying the wires, and it is hardly possible that the present investigation will have the effect of causing a change of sentiment.

A party of Minneapolis aldermen were in Chi[illegible] investigating the underground system. [illegible] of the council to re[illegible], and there is a [illegible] ordered down [illegible] City Electrician Barrett [illegible] to explain the Chicago [illegible] correspondents.

[illegible] ELECTRIC RAILWAY AT DES MOINES.

New York Board of Electrical Control.

There was a large attendance of the representatives of electric light and telegraph companies at the meeting of the Board of Electrical Control Feb. 25th. They were anticipating the discussion of matters materially affecting the interests they represented, but were hardly prepared for the flat-footed manner in which Mayor Grant clinched the former declaration of his policy, by bringing up every one with a round turn.

Letters were read from various companies, showing what progress they were making toward getting their wires underground. The Metropolitan Telephone & Telegraph company, which has shown noteworthy readiness to meet the requirements of the law, stated that fully 90 per cent. of the wires in the conduits are its property, and that in 1888 it had removed, or caused to be removed, 200 poles and 700 miles of wire, and put down 46 cables, containing 4,600 miles of wire, at a cost of $147,000. The report also said that before many months the company hoped to have all its wires underground.

The mayor thought that the company was not doing its best. Mr. Eckert, the general manager of the Metropolitan Telephone company, instanced the work done in the past as an evidence of the good intentions and energy of the company, and Commissioner Gibbens thought that the spending of $147,000 by the company was a proof of its good faith. The mayor, however, thought that such a sum was a very small matter to a company that charged such exorbitant rates, and had such an enormous revenue. It could well afford to make such improvements, and ought to have done more, so as to leave less undone when the time that the wires had to go underground arrived.

Mr. Eckert said that many subscribers would be thrown out of the service if the attempt to do the work in twenty days, given by the board, was made.

The time was fixed at thirty days. "And when we fix a time we mean it," said the mayor, "and the companies must abide by it. This action is not taken to be reconsidered or extended at the next meeting. When the time is up the poles will come down pretty quick, whether the companies take them down or not."

A letter from the United States Illuminating company was read, in which the president said that, although the company believed the subways would prove useless for electric light wires, it will have its test cable ready in forty-five days. The mayor said: "I want it distinctly understood that the forty five days agreed upon for this test at the last meeting must not be entirely taken up in getting a cable. The test must be completed within that time. If it is not, I will take some action."

The expert said that the Western Union company had sent in no report. "Mr. Secretary," said the mayor, "notify that company to take down its poles in the subway streets within twenty days. If they don't act, I will." The time to be allowed was subsequently fixed at thirty days.

The Manhattan Electric Light company stated that it had a contract to light the new Union Square theater and Proctor's Twenty-third Street theater, and asked for permission to string wires on First avenue so as to make a connection. The mayor asked how many poles the company would take down on Third avenue if the permit were granted. Mr. [illegible], the superintendent of the company, said 127. The expert explained that the 127 poles would be removed only to be replaced by others. The mayor turned to Mr. [illegible] and said:

"What do you mean, sir, by trying to mislead me as to

the facts. Had it not been for Mr. Wheeler, I should have voted for the resolution, believing that by the burial of the First avenue line we should get rid of 127 poles on Third avenue." Then, turning to Dr. Wheeler, he said: "I see you are looking after the interests of the [illegible] I am sorry for what I said to you last week, sir."

The application was granted on condition that all companies using the poles should take down other poles elsewhere.

There was still before the board a large number of applications, every one of which was refused on motion of

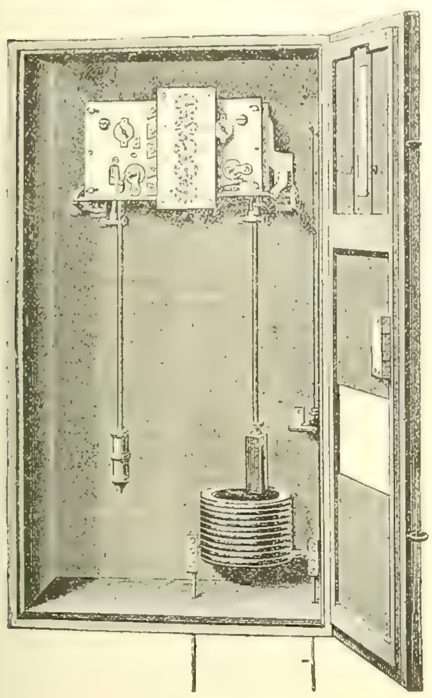


FIG. 1. ARON METER.

the mayor, who said he was determined to bring the companies to the realization of the fact that the wires were really going underground, and he should refuse all applications for new permits until they should manifest the same diligence in getting their wires buried as they had shown in finding reasons for keeping them overhead. The engineer was directed to make plans for an underground duct either in Twenty-seventh, Twenty-eighth or Thirtieth streets. The mayor directed that the police should be notified just what permits had been granted, and stated that he would call on Chief Inspector Byrnes to see that no other work was done. Thus ended a very breezy meeting. The vigorous measures of the mayor are spreading consternation in the camp of the companies interested, who complain that in the face of unquestionable proofs of good faith they are being pushed beyond the limits of possibility. They say that their business is most seriously interrupted, and they cannot carry out their contracts.

Aron Electric Meters.

The accompanying cuts illustrate the Aron meters for continuous and alternating currents. The following description is taken from the London *Electrician:* In the direct current meter, Fig. 1, two pendulums control two distinct clockwork gears. One of these is a standard, oscillating at a regular speed. The other has a permanent magnet instead of a weight, and is variable in speed. The variation is obtained by passing the entire supply of current to be recorded through a solenoid of thick wire placed underneath the magnet. The magnetic influence of this solenoid has an accelerating effect on the pendulum in direct proportion to the current passed through. The difference of speed between the standard and magnetic pendulum is given in direct ampere-hours by differential speed counting gearing, on a similar principle as a gas meter index. The slightest alteration in the current passed through is thus recorded.

In the alternate current type the principle is the same. One pendulum carries an ordinary metal weight, while the other one ends in the shape of a fork, which carries a coil of thin wire. This small coil is connected up in shunt, and moves freely inside a larger one, wound with thick wire, through which passes the main current. The effect of these two coils acting upon each other causes an alteration of the speed of the measuring pendulum, which is proportionate to the product of the existing e. m. f. and the strength of current. The clock went for six weeks without winding up.

The loss of e. m. f. with a current of, say, 100 amperes [illegible] not exceed 25 [illegible] small resistance in the measuring coil.

Electric Train Lighting on the Atchison Topeka & Santa Fe Railroad.

Heretofore the Chicago and [illegible] vestibuled trains on the Atchison, Topeka & Sante Fe railroad have alone been lighted by electricity, but the success attending the trial has warranted the company in extending the system to all its trains running out of Chicago. For the local trains the isolated car system will be used; storage batteries alone will be used. A set of thirty-two cells of the Electrical Accumulator company's 23C type are placed under each car, being charged at this end of the [illegible] in the time intervening between the arrival of each train in Chicago and its departure on the next trip. For the purpose of charging these batteries the Santa Fe company has already begun the installation of a plant at the yards at Eighteenth street in Chicago. In order to avoid the necessity of removing the batteries from the cars, either for charging or replacing with others fully charged, Alexander Thompson, the electrician of the company, has devised a plan of current distribution which enables him to charge the batteries under any number of cars up to the capacity of the dynamo without moving a single cell of battery or interfering in any way with the work of cleaning or repairing the cars.

The sketch shows the general arrangement of the plant and the system of current distribution that will be utilized.

The engine and dynamo will be placed in the boiler house, a tachometer and current indicator being connected here with an automatic break switch that will drop whenever the counter electromotive force in the external circuit exceeds that of the dynamo. The main wires lead to the adjacent end of the round-house that is assigned to the electrician for his repair shop and storage battery work.

Here the volt and ampere meters are connected, and by means of a switch-board connections can be made for charging batteries as soon as set up, so that all spare sets of batteries are kept fully charged, and no set of batteries will ever be issued to a car unless they are fully charged.

From this switch-board an overhead line runs to the passenger car tracks, as shown in the sketch, and two parallel overhead lines are sus-

[illegible] At the end of [illegible]

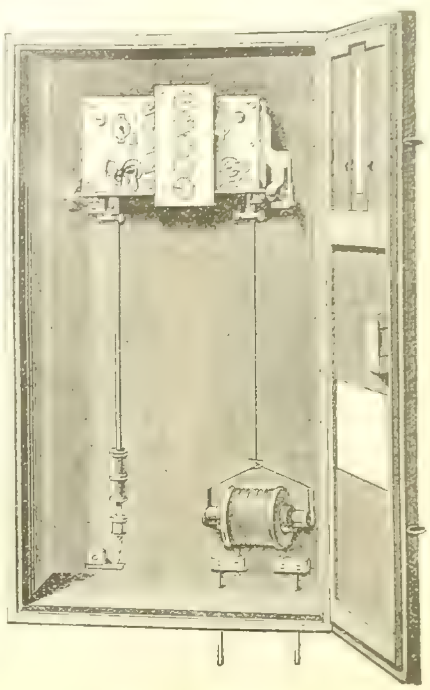
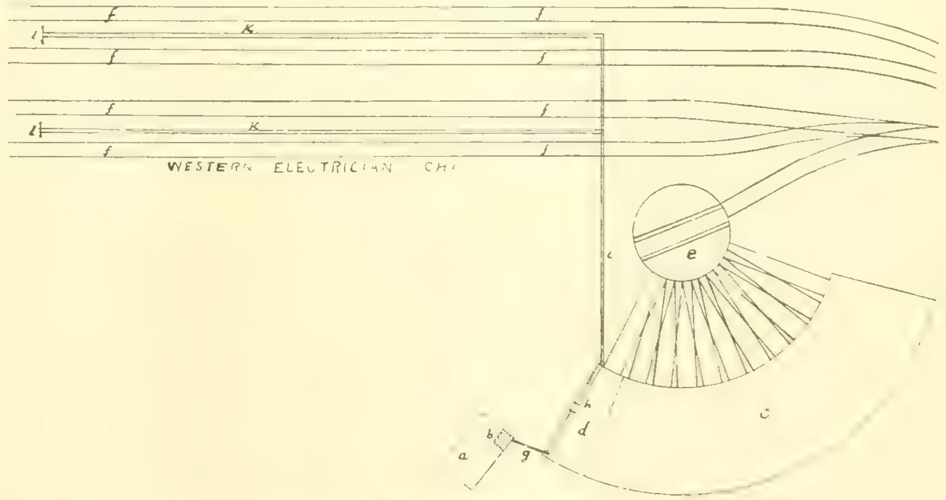


FIG. 2. ARON METER.

case be supplied either from the charged batteries in the round-house or from those under any cars in the yard.

In case of an accident to any part of the engine or dynamo on the vestibuled trains' plants the batteries under the cars of these train can be charged here and lights kept up by this means alone until the necessary repairs can be made.

It is proposed to light the round-house and various shops of the Santa Fe company here



ELECTRIC TRAIN LIGHTING ON THE ATCHISON, TOPEKA & SANTA FE RAILWAY.

pended for a distance of five hundred feet between each pair of the four tracks. On each of these lines are placed a number of trolleys, similar to those used in the overhead electric street railway systems, each connected to, but insulated from, a corresponding trolley on the parallel suspended wire, thus making a sort of overhead traveler riding on the two wires.

Flexible conductors are attached to each pair of trolleys, fitted with suitable couplings at the lower end for attaching to the battery wires of the cars, so, as soon as any car arrives on any one of the four tracks, a traveler is run out on the nearest pair of wires to a point opposite the car, the connections made to the battery wires, and

with the electric light, using the storage batteries and avoiding all necessity of running the plant at night. Mr. Thompson has [illegible] of the installation of this plant. The Santa Fe company is the first to extend electric lighting to all trains, and in taking this step [illegible] of this road show themselves [illegible] times in adding to the comfort of the passengers.

Reference letters in the accompanying diagram indicate as follows: [illegible] Electric plant. [illegible] Round-house. [illegible] department. [illegible] Turn-table. [illegible] Mains from dynamo [illegible] traveling mains; [illegible] Double trolley [illegible] supports.

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AN interesting article by Alexander Watt on peculiarities of electro deposition appears in this issue.

IT will be remembered that at the last telephone convention many references were made to the trouble which had been caused by the proximity of motor circuits to telephone lines. This trouble has led to a suit at Akron, Ohio, which is referred to in a letter from that city which appears in the correspondence column. The [illegible] test suit.

[illegible] the electric lighting of railway coaches is abundantly demon[illegible] appear in this number [illegible] for electrical distribution in a coach yard in Chicago is described and [illegible] read before [illegible] presented, show[illegible]

[illegible] New York Board of [illegible] appears [illegible] Mayor [illegible] bury their wires at once, and he states he has no inten[illegible] spread consternation among the companies which maintain [illegible]

specified time, he proposes "to act." In other words, he intends to remove the poles. He says he will not stand any trifling or any delay. With Mayor Grant occupying such a threatening attitude at the very beginning of his term, the prospect before the corporations is not entirely to their liking.

A DECISION of considerable importance to all companies which maintain overhead circuits is summarized in the Detroit letter. At the time of a fire in that city the firemen were impeded in their work by the wires strung through an alley. The firm whose building was destroyed by fire held that its loss would have been much less had the firemen been able to work without obstruction. The firm thought that the company which maintained the wires was responsible for a portion, at least, of the loss, and brought suit to recover. The court held a contrary opinion, and decided that the wires were lawfully in the street, and, therefore, the company could not be held responsible for any damage which was caused by their presence in the thoroughfare.

THE interview published in this issue, in which Prof. Barrett, city electrician of Chicago, supplements his remarks at the electric light convention on the subject of underground conduits, shows that he has lost none of his faith in this system. All of his recent investigations, he says, have tended to confirm his belief, and he is more confident to day than ever before that the underground system will force itself upon the electric light companies. He favors a free discussion of the subject, and is not afraid to have the faults of the system pointed out and discussed, for in this manner he may hope to receive suggestions for improvements. He frankly declares the overhead wires a public nuisance in large cities, and takes the position that the electric light companies are pursuing a poor business policy in opposing public sentiment in the matter of burying wires.

THE Dempsey bill for the regulation of telephone rates which the Missouri legislature is now considering reduces rentals so materially that managers in the state say it is impossible to continue business and at the same time conform to its provisions. The views of two of the leading managers in Missouri are given in the letters from St. Louis and Kansas City. They both agree that, if the measure becomes a law, the companies will simply be obliged to suspend operations. Since its introduction, the Dempsey bill has been amended so that the maximum rate for telephone service will be $75 instead of $50 per year. Mr. Durant of the St. Louis company says the former rate would be utterly ruinous to his company, and that he would not accept the exclusive right to operate telephones in St. Louis for a century even at $90 per year. Mr. Durant said recently, in his testimony before the legislative committee on the telephone question, that his company considered burying wires practicable, and had determined to place their wires underground in St. Louis.

AT the nineteenth annual meeting of the New England Association of Gas Engineers at Boston, recently, President Norton made his annual address in which he referred to the future of the gas industries and the growing competition of the electric light, which he recognized had "come to stay." He believed the point of competition in the future would be improvement in the burner. He looked to see great development in the utilization of the energy that was now wasted through want of such improvement, and thought that the scientific efforts which had, during the past decade, brought the electric lamp to its present state, would cause an equal advance in the gas burner or lamp, when the [illegible] would be settled. He thought it would [illegible] for gas companies to offer pecuniary in[illegible] to inventors to improve the means of using gas as an economical illuminant, and he thought that the inventors would respond. Ad[illegible] electric lighting by gas companies, he saw no hindrances, and it was plain, [illegible] company could furnish [illegible] any independent organization. He believed that the sales of gas for illumination would increase steadily, despite any rival agent, but if this should not prove to be true, the sales of gas for purposes of heat and power would more than balance the difference.

THE Indiana legislature last week repealed the act of 1885 regulating the telephone charges in that state, and the bill was immediately approved by the governor. This action on the part of the legislature and governor was hailed with delight by the old subscribers of the telephone company, who through the action of the legislature of 1885 had been deprived of the benefits of the telephone. In signing the bill passed last week Gov. Hovey said it gave him greater pleasure than any other bill he had approved during the session of the present legislature. This sentiment will be approved by the business men of the entire community. The effect of this action by the Indiana legislature will not be confined to that state—it will have a far-reaching influence, and should have a tendency to warn legislators in other states against hasty action directed against telephone companies. Indiana tried to crush a telephone compone company; it failed, but the force of the assaults against the company reacted upon its opponents, and after four years of warfare the telephone company was voluntarily granted by its former opponents all the rights and privileges for which it had contended.

A LETTER from Major Flood Page, relating to the progress of electric lighting in the United Kingdom, which recently appeared in a London daily, has been attracting considerable attention. There are in London, he says, nine central stations, and the number will soon be increased to twenty-one. Fifty stations will be in operation in Scotland and England "before very long." To illustrate the advance which has been made, Major Page institutes a comparison between the number of gas companies formed within ten years after the passage of the Gas act and the number of electric light corporations already organized. From 1810 to 1820 only twenty companies took advantage of the Gas act. The number formed during the first ten years following the enactment of the Electric Lighting act will be far greater. The writer continues: "It is not possible to arrive at the amount of capital already invested in electric light companies in the United Kingdom, as a very large proportion of the work is being done by private companies; but the limited companies engaged in electric lighting have a nominal capital of more than £4,000,000, of which about half has been called up; while it appears, from the return to parliament already quoted, that from the year 1810 to the year 1850 134 gas companies were established, with an aggregate capital of £6,602,010, so that it seems manifest that within forty years from the date of the first Electric Lighting act a very much larger sum will have been invested in connection with electricity than was invested in gas during the forty years from the passing of the first Gas act." In reference to the London underground railway he says: "I think I should not exaggerate in saying that we may look forward with good hope to seeing, before many years pass over our heads, the Metropolitan and District railways worked by electricity. The gain and comfort to the many millions who make use of these railways would be incalculable. I am not unaware of the difficult and complicated nature of the many problems, scientific and commercial, which will have to be solved before this desirable end is attained. Nevertheless, I venture to think that the scientific difficulties will be more easily overcome than those connected with the expense of making such extensive changes as will be involved in the substitution of electricity for steam." He says the outlook is hopeful: "I think, therefore, that all who are interested in the progress of electricity and who is not? may well be hopeful. For my own part, I look forward to a sure and certain development of electricity in all its branches, and think that before long we shall be as familiar with electric lighting and electrical motors, and perhaps phonographs, as we now are with its use in connection with house bells, telephones and telegraphs."

Some Peculiarities of Electro-Deposition.[1]

BY ALEXANDER WATT.

PART I.

In depositing metals from solutions of their salts by electrolysis, the eye of the experimentalist is often attracted to some unusual condition or form of the deposited metal for which at the moment he is unable to account, and which in some cases even further reflection fails to elucidate. In calling attention to a few of the many "peculiarities" of electro-deposition which I have met with in my own practice, I do so more for the purpose of recording the facts than with a view (except in one or two instances, probably) to suggest explanations which, for aught I know, may be beyond the reach of any of us. In order that the peculiarities referred to may be considered individually, I purpose describing them under separate headings, giving the name of the electrolyte in each case from which the result was obtained, as also the conditions under which it was electrolytically treated.

Refusal of bright metallic surfaces to receive the deposits.—It is a well-known fact that on highly polished surfaces of metals the electro-deposited metal can seldom be made to adhere with tenacity, but more especially is this the case with gold solutions. It is true that a mere film of gold or silver may be deposited upon polished brass or German silver which will stand the friction of the moist revolving scratch-brush, but a stouter coating would inevitably "strip" or peel off the underlying metal, unless the brightened surface received a previous scouring with pumice-powder and water, or a coating of mercury by dipping the article to be plated in the ordinary mercurial solution used for such purposes. And this disinclination of metals to adhere to bright metallic surfaces is more particularly noticeable, I believe, when we attempt to coat any given metal with the same metal. Indeed, I have before had occasion to express my firm belief that metals do not adhere well to their kind when deposited by electrolysis, and I am even disposed to think that each time an article is removed from a bath for the purpose of examining it, even for an instant, the subsequent deposit forms a distinct layer upon the previous film, and not a perfect continuation of the original deposit. In the case of nickel this is often noticeable in a marked degree, and I have known a rod of brass, or "stop" suspended from the negative conducting rod of a nickel bath, to be coated with innumerable layers of the metal, each of which curled up and separated from its predecessor, although the rod had never been removed from the liquor. In this case there is little doubt that each time the bath was used from day to day, the new deposit which took place upon the rod formed a separate and distinct layer upon the surface of the metal which had been deposited on it the day before. In connection with this latter view, and the disinclination of metals to deposit upon bright metallic surfaces, the following curious result was obtained some time since when pursuing a course of experiments in the electro-deposition of zinc. In these experiments it was desirable to deposit zinc upon thin sheets of the same metal, for which purpose the purest commercial article was procured. In most instances the plates of sheet zinc, before being used as cathodes, were pickled and scoured, so as to present a clean and slightly rough surface; but on one occasion the plates—which presented the usual bright surface of rolled zinc—were not so carefully prepared as I have indicated, the result being that the deposited zinc only partially covered the cathodes of the same metal, while, at the same time, the film was absolutely non-adherent, and could be stripped off the zinc plates by simply lifting the metal with the point of a penknife, and then gently pulling it [illegible] from the bright surface of the zinc [illegible]. On examining the deposit before it was removed, it was found to be riddled with holes, through which the bright sheet zinc was quite visible, while a portion of the stripped metal, when [illegible] up to the light presented a very peculiar net form appearance, the metal (zinc) being at the same time perfectly reguline, tough, and chemically pure. I determined to treat the porous zinc deposit as a photographic negative, and to obtain prints or positive proofs from it in the same way as that adopted in the ordinary processes of photographic printing. A reproduction is shown in Fig. 1.

FIG. 1.

Deposit only on lower corners of the cathode.—When electrolyzing a solution of nitrate of lead, consisting of 50 grains of the salt dissolved in 10 ounces of water, with the current of one small Daniell cell, I found that the lower corners of the plate slowly received a deposit of lead, but beyond these limits the metal refused to extend with the current employed. An illustration of the form of the deposit is shown in Fig. 2. When the liquid was diluted and two cells used, an irregular or patchy film was obtained, the metal only appearing on parts of the cathode, while portions of the deposit were of a non-metallic character.

FIG. 2.

FIG. 3.

FIG. 4.

No deposit on lower corners of the cathode.—A result of an opposite character to the foregoing was obtained during the electrolysis of a solution of pertartrate of iron, prepared by digesting moist hydrated peroxide of iron in a boiling solution of tartaric acid, the liquid being afterward diluted. With the current from four Daniells in series no deposit was obtained while the cathode remained stationary, but when it was briskly moved about in the bath deposition of iron gradually took place on all parts of the immersed surface of the cathode, except at the lower corners, where there was no deposit, while the upper portion of the deposited metal assumed an irregular or jagged appearance, due to the negative plate having been kept in motion. An illustration of this result is shown in Fig. 3, in which the white surfaces at the lower corners of the plate indicate where the metal was not deposited.

Deposit commences from the edges of the cathode.—When a very weak solution of acetate of lead—50 grains of the salt dissolved in 10 ounces of water and slightly acidified with acetic acid—was electrolyzed with the current from two Daniells in series, a deposit of lead at first slowly formed on one edge only of the cathode, but after a short time a corresponding film formed on the opposite edge of the plate, as in Fig. 4, the two films gradually and very slowly extending toward the center of the cathode, while no deposit whatever occurred either upon the upper or lower surfaces of the plate. After the cathode had been in the bath about fifteen minutes from the commencement of the experiment, minute crystals began to form on the surface of the films referred to, from which point the lateral extension of the films appeared to cease, the plate somewhat assuming the appearance shown in Fig. 5. A very similar result was obtained when a solution of basic nitrite of lead was electrolyzed with the current from a single Daniell cell.

Deposit only on upper part of the cathode.—On electrolyzing a solution of sulphocyanide of lead (prepared by digesting moist carbonate of lead in a hot and strong solution of sulphocyanide of potassium, the solution being afterward cooled and diluted) with the current from one small Daniell, a deposit of lead slowly [illegible] electrolyzing weak solutions [illegible] over.

T[illegible]

[1] Abstract of paper in the London *Electrical Engineer*.

Chicago Agency of the Westinghouse Interests.

[illegible] has been [illegible] general district agent of the Westinghouse companies for the states of Illinois, Indiana and the southern peninsula of Michigan, with headquarters in Chicago. Mr. Fairbanks will retain the handsome offices of the United States company, in the Rookery building, and the business of the Westinghouse Electric company, United States Electric Lighting company and Sawyer-Man Electric company for this territory will hereafter be conducted from this office, with a single staff of men. The individuality of the different companies will be retained, the Westinghouse company furnishing to Mr. Fairbanks his alternating apparatus, the Sawyer-Man the lamps and fixtures, and the United States company isolated incandescent and arc apparatus. Mr. Fairbanks is a man of experience in electric lighting matters, having been connected with the Westinghouse company in both its business and engineering departments for some years. He is well and favorably known to the trade, and, his previous operations having been mainly in the west, was naturally selected to take charge of the combined interests here. The Westinghouse company is sure to do a heavy business in this territory, and Mr. Fairbanks' previous experience peculiarly fits him for this responsible position.

FIG. 5.

FIG. 6.

FIG. 7.

Electric Lighting of Trains.

At the last meeting of the New York Railroad club, Dr. H. R. Waite read a paper on electric lighting of trains. Mr. Waite quoted at length Mr. Blodgett's description of the system adopted on the Boston & Albany railroad, which was read before the American Institute of Electrical Engineers in July, 1887. Mr. Waite continued:

The Boston & Albany railroad had then successfully operated the Julien system of lighting upon its trains for about six months. They have had it in use at this time uninterruptedly for a period of six years. Their experience in the use of this new system has not been unlike that which necessarily accompanies pioneer work in the introduction of new methods in connection with any great enterprise.

In the first place the storage battery, which is and, so far as can be determined by present experience, must continue to be the basis of any successful system of electric car lighting, was at that time little understood. Its application to commercial uses was just commencing, and the many facts essential to its successful use, which can be learned only as the result of experience, were yet to be ascertained. Calculations and expectations as to its durability, efficiency, and its behavior generally, were, with few exceptions, based upon laboratory experiments, and were therefore largely conjectural. The adoption of this system as a sole means of lighting railway trains required, therefore, not a little courage on the part of the railway officials who were the first to use this system, as well as on the part of the company who were its introducers, and between whom the risks and the honors were about equally divided.

There can be no better comment on the results of the experiments thus made than the present facts in connection with railway car lighting. Almost immediately after the equipment of the first express trains on the Boston & Albany railroad running between Boston and New York the Pullman Palace Car company introduced the same system upon their vestibule trains running between New York and Chicago, while the Pennsylvania railroad at about the same time introduced it upon the palace cars upon their Philadelphia [illegible]. Following these companies the [illegible] storage system was introduced upon the [illegible] railway, the Grand Trunk railway of Canada, the [illegible] Atlantic, the Intercolonial, and later upon the Chicago, Milwaukee & St. Paul. That the system has not been [illegible] to a still greater extent upon American railways

[illegible] experiments have for a [illegible] with a view to such [illegible] the practical advantages of a complete isolated electric lighting plant for each separate train. It has from the outset been obvious that could this result be successfully accomplished the following advantages would follow:

1. By generating the electrical current upon the train a supply for lighting and signaling, if desired, would be always available, thus avoiding the many difficulties arising from dependence for charging batteries upon electric lighting stations [illegible].

2. All of the electrical arrangements would be under control of those upon the train, thus making it possible to secure more adequate attention to the conditions necessary to success.

3. The amount of storage battery required would be greatly reduced, thereby avoiding the necessity of carrying so large an additional weight [illegible] as well as largely reducing the cost of installations and the cost of maintenance for each train.

Experiments in the direction of realizing the results above indicated [illegible] the Julien storage battery were carried out simultaneously by the Julien Electric company, the Pullman Palace Car company, and the Barritt Railway Electric Car Lighting company.

The experiments made by the Barritt company upon the Connecticut River railway were first brought to a successful completion by the use of a dynamo and engine placed in the baggage car of a train the power for running the engine being taken from the locomotive boiler. The train upon which this method of lighting was first successfully introduced consisted of one combination baggage car and smoker, and four ordinary passenger cars, the train running between Springfield and Northampton, Mass. The lights were distributed as follows: In the baggage car and smoker, thirteen; in one passenger car sixteen—one twelve and two ten. In addition to these there was a lamp on each car platform, making a total upon the train of seventy-one 16 candle power 45 volt lamps. The equipment for the supply of these lamps consisted of a 7 horse power engine and a specially made 60 light dynamo, the total equipment in the baggage car occupying a floor space of six by four feet with a height of four feet. There were used in connection with this machinery 23 Julien accumulators, type "19 B," all of which were placed underneath one of the passenger cars. The steam from the locomotive boiler was employed during the running time of the train to run the engine and dynamo in the baggage car. The storage battery was thus abundantly charged during the daytime as well as at night, when the dynamo was also run, the battery being charged and discharged at the same time, thus securing not only an abundance of light in every car upon the train, but light of a remarkably steady, clear and brilliant character. This installation has been cared for from the beginning, without difficulty, by the baggage master on the train. He was enabled after very little instruction to operate it with entire success.

As to the cost of maintenance, which is one of the most essential questions involved, the renewals of battery up to January 19th last, including repairs of machinery and depreciation upon the entire plant, amounted to less than 5 per cent. per annum.

Underground Conductors.

In the discussion on burying electric wires, the following communication, recently published in the Kansas City *Globe*, is interesting:

We are most emphatic and clear in the opinion that it will be a very great injustice to all concerned if your state or city should enact laws to compel all classes of electric wires to go under ground. It seems to us that the experience of the city of New York in this matter should be conclusive. They have been endeavoring for two years past to find some system that would enable them to run electric wires underground safely, but so far have failed. They have had difficulties of every possible character and have demonstrated, we believe clearly, that up to this time there is no practicable system by which electric light wires, even of low tension, can be run underground with entire safety. We do not believe that public sentiment, if fully [illegible] We are per[illegible] that are in [illegible] ations; [illegible]

other city in the country is there anything like the necessity for getting wires [illegible] New York [illegible] therefore, be entirely safe for any other city to wait until New York has discovered and put into practical operation a safe method of doing this work. At the present moment no electric arc light wires, either of high or low tension, are operated practically in New York. Most of the talk and all of the push in this matter have been done by the New York Subway company, a private corporation whose aim is to get a profit from the rental of wires to the electric light, telephone and telegraph companies. They have already expended hundreds of thousands of dollars in building useless conduits, and their only hope of getting any return whatever is by forcing the companies to go under ground. So far they have not been successful, and the Western Union Telegraph company, which in the outset put a good many hundreds of miles of their wires under ground in order to give the matter a thorough test, have now removed them and placed them on poles again, as they found it entirely impossible to operate them satisfactorily or safely in the conduits. To-day there are far more miles of overhead wires in New York than there were last year, and the Subway company is now using and trying to manufacture public opinion in view of this fact. Kansas City and Missouri can certainly afford to wait before taking any legislative action until something far more definite and practicable has been accomplished in New York.

If finally a practicable system should be obtained and the control of it placed in the hands of one or more corporations, they could compel electric light, telegraph and telephone companies to pay whatever prices they pleased for the occupancy of the conduits at even at a moderate price the expense would be prohibitory, and would, in our judgment, be a very great hindrance to the business, and would, in all cities of moderate size, cripple the arc light companies as well as the other companies, and in many cases lead to their abandonment.

THE BRUSH ELECTRIC LIGHT COMPANY
By G. W. STOCKLEY, President.

Something Electricity is Doing.[1]

BY CHARLES BARNARD.

[illegible]

Several years ago, at one of the exhibitions of the Massachusetts Charitable Mechanic association in Boston, there was a display of small steam engines many of which were supplied with steam and were in motion. One exhibitor, who had a portable boiler with engine attached, did not use the steam supplied to the others, and his exhibit would have been "dead," or idle, had he not put a belt from a neighboring engine to his own. Most of the spectators did not notice this device, and imagined the engine was really at work on its own account. At the hour for closing the hall, when all the steam was shut off and the various engines came to rest, the belt to the "dead" engine was thrown off, and, to the amazement of those present, the idle engine instantly started off and ran at full speed for several minutes before it slowed down and stopped.

The dead engine at work was an example of what is called the "conversion or transmission of energy." The engine was connected with an air-tight boiler, and when set in motion by means of the belt, it acted as a compressor, and filled the boiler with air under pressure. When released, it became itself a prime mover or motor under the pressure of the air stored in the boiler. The throttle being wide open, it ran at full speed until the compressed air was reduced to its normal pressure. The energy or power developed by the live engine was transmitted through the belt to the dead engine, and a part of this energy was for the time stored in the air within the boiler. When the supply of energy was cut off, the stored energy in the boiler reappeared as mechanical power on the previously dead engine.

It is a curious fact that at the International Exhibition at Vienna, in 1873, a parallel phenomenon was observed. There was at the Vienna Exhibition a display of dynamos of the Gramme type, or, as they were then called, "Gramme machines," and in this exhibit one of the machines had been connected with an engine and was at work, while a second machine, that stood near it, was at rest. Desiring to show both machines in motion, H. Hippolyte Fontaine, who was in charge of the Gramme display, conceived the idea of joining the two by some suitable conductor. As far as can be learned, two dynamos had never been joined, and it was not known what would be the result. By using a long cable, borrowed from a neighboring exhibitor, he coupled the dynamos and, to his surprise, the second or dead dynamo started off at full speed. Now it happened that the cable was a long one, and M. Fontaine's device practically demonstrated the conversion of energy and its transmission to a distance. The two dynamos stood side by side, yet if the conductor had been stretched out in a straight line they would have been two kilometers apart, [illegible] the engine to the [illegible] al power [illegible]

[illegible] cheap and abundant [illegible] clothed [illegible] the economic [illegible] from other prime [illegible] the gas engine, the dy[illegible] [illegible] The turbine [illegible]

is water power. The steam engine is, so far, the best motor we have, because, while it is theoretically wasteful it can be operated anywhere on land or sea. This problem of conversion and transmission of energy, therefore, is mainly based on the turbine and the steam engine. They convert the energy stored up by nature, and make it available as useful motive power.

Every year it becomes more and more important that we shall be able to convey the power developed by these two prime movers to the work we wish performed. Hitherto we have carried the work to the motor. We can no longer do this at a profit, and the power must be conveyed to the work. The price of land in cities compels us to erect very tall buildings, and to use power on every floor. The subdivision of labor and the specialization of manufactures make it more and more important that motive power be divided into very small fractions. We want single horse powers, and even one-tenth or one-eighth horse powers, with variable speeds, and under as complete control as gas or water. Moreover, there is a tendency to return to the old idea of small shops, with one or two artisans in each, for the production of those more or less artistic articles that demand both skill and power. Domestic life, particularly in cities, calls for motive power to run elevators, lift water, and to move sewing machines and laundry machinery. A city apartment house can no longer be operated without power of some kind. This rapidly growing demand for small powers is evident in the great number of small steam, gas, and water motors now on the market. They are simply the result of the demand. Social science and humanity are deeply concerned in this matter, and, while they may not know it as yet, they should earnestly consider the subject if the evils of the factory system and tenement house labor are to be abated. The truest charity should consider whether it may not be possible to reduce the crowding and misery of our manufacturing centers by changing our system of transmitting energy as well as by trying to improve the factories and tenements. Instead of helping people in the factory, may it not be wiser to carry the motive power round which they are huddled to some other place with happier and more healthful surroundings?

These things are perhaps elementary, yet they are essential to a right understanding of the new method of converting energy now placed before our commercial and industrial communities. Two methods of distributing energy are already in use. One plan is to multiply small motors, to use one engine for one machine, or for one very small group of machines. By this plan the stored energy of coal is transmitted through the streets (or gas-pipes) to each little motor. This method, while in general use, is too expensive. The more we multiply steam engines the higher the cost of the power. Twenty five horse power engines are proportionally far more costly to build and operate than one one hundred horse power engine. The second method of distribution is by belts and shafting, which includes gearing. This system is necessarily limited in range Power cannot be distributed by belts (as by cable) for more than two or three miles, and for moving machinery not over a few hundred feet, or more than the height of an ordinary factory. Shafting is limited to perhaps half a block. With both belts and shafts there must be heavy and massive construction to secure the alignment of the shafting and to prevent waste of power through unnecessary motions, jarring, or shaking of the building or machinery. Both are also wasteful by reason of friction. Power can also be transmitted by means of water or air in pipes, but both hydraulic and pneumatic distribution are expensive and wasteful.

It is now thought that Fontaine's experiment at Vienna offers the key to the ultimate solution of this question. Previous to 1873 there had been, all through the earlier years of this century, many attempts to use electricity as a source of power. It had been known that electricity could be used to induce magnetism, and that magnetism could be converted into useful power. From the researches in this field had come many forms of electro-magnetic motors. By a rapid evolution from the crude to the perfect these motors advanced until they promised to be of real value, but they were hampered by one almost fatal defect—expense. As converters of energy they were dependent on a battery as a source of supply, and it was simply "not good business" to burn zinc at seven cents a pound when, with the steam engine, we could burn coal at one-fourth of a cent a pound. With the invention of the Gramme machine and the many forms of dynamos that immediately followed it the question assumed a wholly new phase.

The dynamo, stripped of its technical details, is a machine for transforming energy. It converts mechanical power into that phase or manifestation of energy which we call electricity Mechanical power is cheap and the dynamo made electricity cheap. The moment electricity was reduced in cost the electric motor assumed a commercial value. It ceased to be a mere laboratory apparatus and became a practical machine for converting electrical energy back into mechanical power. It is not easy to comprehend the immense importance of this latest evolution of machines and all that it means when we say that we have now joined the steam engine, the dynamo and the motor in one. It [illegible] great an improvement as the invention of the steam engine itself. It is not necessary here to enter into the [illegible] of the electric motor as a machine. The point to consider is the position of the electric motor as a transformer of energy and its place in the arts, business, transportation, and manufactures.

[illegible] now a regular trade product and can be bought in a variety of styles and shapes, ready made, [illegible] steam engine or a turbine. They are made in a number of sizes ranging from one tenth [illegible] power upward. A motor of one-eighth horse power weighs [illegible] fifteen pounds, and measures [illegible] It can be placed in any position, right side up, upside down, or attached sidewise to a wall, and will deliver power from its pulley in any required direction. Larger motors occupy more space in proportion, but any motor, whatever its size, can be placed in any position

where it rests firmly on its base. An electric motor will operate in any ordinary temperature and in any climate, provided it is kept dry. It is practically cold, that is, it gives out no injurious heat while at work. Even when running at very high speed it is safer, so far as mechanical injury is concerned, than any other form of machine or motor. Of its two chief points, the magnets and the armature, only the latter is subject to wear and tear, and this wear is confined to the bearings. The energy passing through the magnets appears, so far as our [illegible] show us, to have no effect on the material of the magnets, and they remain practically unchanged through years of service. When not at work the motor is at complete rest, and all cost of maintenance ceases, except the interest and slight cost of keeping such enduring metals as copper and iron from injury by rust or fire. Added to these advantages is the fact that the electric motor receives its supply of energy through a wire.

It is difficult at first to comprehend how much is meant by these simple statements. First, we may observe the

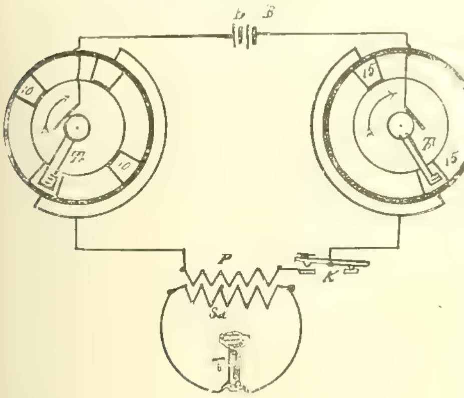

FIG. A.

structure of buildings where power is used. In such buildings the walls and floors must be strong and stiff, to resist the jarring and weight of heavy engines, and to keep the shafting in line, so that all points of bearing and strains shall be firm and not wasteful of power by unnecessary friction. With the electric motor, particularly if the power is subdivided among a number of small motors, lighter and cheaper buildings can be used. In place of one large engine in the basement, with belts and shafting to the upper floors, the engine may be in another building, perhaps a mile away, and the dynamo may transmit its energy through wires branching to every floor, or to a hundred motors on one floor. With the electric motor it will be possible to erect, as we must, very tall buildings and have "power to let" on every floor. This will not only cheapen the cost of buildings, but enhance the value of real estate by making it possible to put many power-using tenants under one roof.

(*To be Continued.*)

A New System of Multiplex Telegraphy.[1]

BY LIEUT. F. JARVIS PATTEN, U. S. A.

PART I.

The paper this evening has a single object, its purpose being to describe the salient features of a system of multiplex transmission by telegraph, and as the system is still in the experimental stage, I shall have more to say concerning

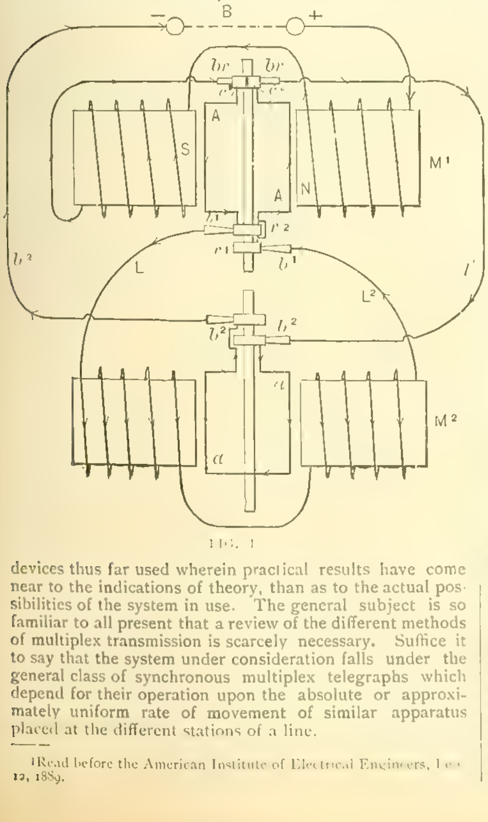

FIG. 1

devices thus far used wherein practical results have come near to the indications of theory, than as to the actual possibilities of the system in use. The general subject is so familiar to all present that a review of the different methods of multiplex transmission is scarcely necessary. Suffice it to say that the system under consideration falls under the general class of synchronous multiplex telegraphs which depend for their operation upon the absolute or approximately uniform rate of movement of similar apparatus placed at the different stations of a line.

[1] Read before the American Institute of Electrical Engineers, Feb. 12, 1889.

[illegible] trailer, which is caused by some form of mechanism to [illegible] as shown [illegible] a convenient number of segments [illegible]. Each of these segments [illegible] a branch circuit, which includes all the necessary instruments for a single operator sending or receiving. If we consider the trailer motionless and resting on, say, the segment No. [illegible] the two operators at [illegible] line would each evidently find the main line connected to his sending and receiving apparatus for the time being, and if the trailer remained in the position shown they could hold uninterrupted communication with each other. If, now, the trailers were moved to the segments No. 15, in each distributor, then operators No. 15 ateachend would have the line. It will now be understood that if by any means the trailers could be revolved uniformly around the circle the line would be given in turn to any number of operators connected, in the manner described, to the main line.

Early attempts at multiplex transmission did not go farther than this. The line was given slowly first to one and then to another operator, the time that each in turn could hold communication being indicated by a common metronome. Later attempts went farther than this, the idea being to make the trailers revolve at a high rate of speed, moving, in fact, so fast that each pair of operators in turn is connected to the line so fast that he is practically unaware that the line has ever been taken from his circuit. It is easy to see that this would not require a very high rate of speed. If it be assumed that the operator can make the shortest signal with his key in one-fifth of a second, it only becomes necessary to move the trailers at a speed of more than five revolutions in a second, when it would evidently be impossible for any of the operators to close a key without having the line during this interval connected to his branch circuit. In order that the signal sent by any operator shall reach the corresponding operator at the other end of the line, it becomes necessary, of course, that the trailer at the two stations should be on the same identical segments at the same instant of time. The solution of

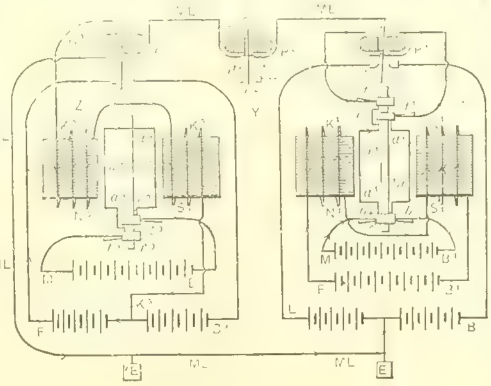

Fig. 2.

this problem will then consist in causing the trailers, however far apart, to move with absolute uniformity and precision. If this can be done at a sufficiently high rate of speed then a single wire may be given in rapid succession to a number of operators at each end, and all can simultaneously communicate over the single wire without interruption from or interference with each other.

Such a system has for its object the utilization of all the currents which in a given unit of time can be distinctly transmitted over a single wire. If it is assumed that in average Morse transmission five pulsations of current or makes and breaks of the circuit occur in every second, then if n represent the number of separate currents that can be made to succeed each other during this interval of time, $\frac{n}{5}$ will represent theoretically the number of receivers or operators that can work the same wire at the same time.

Any system based upon the foregoing theoretical consideration, which consists practically in giving the line for a brief interval of time to a number of operators in rapid succession, rests fundamentally upon the fact that the identical revolutions in the same period of time of certain parts of the apparatus at different stations can be maintained continuously; in other words, a perfect synchronizing device of some sort must be the fundamental starting point without which any such system will remain what a noted English scientist has aptly described as a "mere figment of the intellect."

In the literature of the telegraph, already large, synchronizing devices are common, and in the books their operativeness is generally taken for granted. All such devices, with a single exception that occurs to me, are founded upon the isochronous motion of some mechanism which, under the operation of natural forces, has a fixed rate of movement, and preserving this motion unvaried so long as these forces are acting freely. The pendulum and the tuning fork perform their oscillations of great or small amplitude in the same period of time, their rate of movement is, therefore, described as being [illegible]. Two such exactly similar devices when in motion, therefore, should be in [illegible] with each other, but all these devices once set in motion immediately tend to a state of rest, and it becomes necessary to apply constantly some extraneous force to keep them in continued operation, they must continually receive an intermittent impulse to prevent them from coming to a

[illegible] effort. [illegible]

tery. In this apparatus the diaphragm of the receiving [illegible]

Fig. 3.

motor moving in perfect unison with the changes of potential in the generator and the line circuit. My experiments in this field were first directed to the application of this peculiar relation of the alternating current generator and motor to a synchronizing device, only to reach the conclusion, however, that it could not be made operative on a circuit of any considerable length.

Further experiments led to a simpler solution of the problem involving few uncertain elements.

I had constructed two ordinary direct current motors of the simplest form, an ordinary two pole field and single coil armature conveniently arranged for use as either direct or alternating current machines. The armature circuits were connected at one end to an ordinary two-part commutator and at the other to two insulated ring contacts. They are shown by a simple diagram in Fig 1, where both are connected in a single circuit. The armature of the machine M^1 was normally open at the ring contacts, and could be closed either by connecting the ring or through an external circuit. Such a circuit was made to include the field coils of the machine M^2, and the armature of this machine was connected in the direct current circuit from the poles of the battery. Thus connected, the two machines moved as one; the machine M^2 following all the fluctuations of speed in the machine M^1, as if their armatures were carried by the same spindle, the speed being varied between wide limits. To convert this mechanism into a synchronizing device in such a way that the machines could be placed at a great distance from each other was another step. As there was evidently an alternating current in the external loop connected to the armature of the first machine, the reversals of current in this circuit must correspond in time to the half revolutions of the armature of this machine, and an ordinary polarized relay connected in the loop would vibrate in unison with the half revolutions of the armature in the machine M^1. The second machine could therefore be made operative at a distance by simply connecting another relay in an independent line circuit and causing the latter to reverse the current in the second machine. This arrangement, which constitutes the fundamental synchronizing device, is shown in Fig. 2. Here the first machine placed at station *X* has a polarized relay connected in the external armature circuit, and the relay vibrates in response to the reversals of current in the armature of this machine, which correspond accurately to the half revolution of the machine at X. A line circuit extends from the fixed point of the relay vibrator to the distant station *Z*, where it includes the coils of another relay and returns to the middle point of the line battery *L B* at X, the opposite poles of which are connected

FIG. 3A.

to the contact stop of the relay at this station. From these connections it results that any relays in the line circuit will be actuated by reversed currents in unison with the half revolutions of the machine at X. At any distant station, as the one shown at Z, another machine has its [illegible] connected as follows: One terminal to the fixed point of the relay and the other to the middle point of a local battery, the opposite poles of which are connected to the contact stops of this relay, the armature of this machine being connected through ring contacts and brushes to an independent source of direct current. Connected in this manner the two machines will move in perfect unison even at very high speeds, though separated from each other by any distance through which a polarized relay can be made to work. [illegible] armature the [illegible] evidently move in [illegible] and I have seen such machines reverse instantly at a speed of several hundred revolutions a minute, and go apparently as fast in the opposite direction, and this even when provided with a fly wheel of moderate weight.

This difficulty may be overcome in a variety of ways [illegible]

effective one is shown in Fig. 3, which represents a form now given to the armature of the driven machine; it has two coils in series connection, but wound with their poles at right angles to each other. This armature, being placed in a single field, I had supposed would move at only half of the speed of the first machine; but, on the contrary, the synchronism was perfect, the motion was continuous in direction and it has never been known to reverse. The analysis of its action is shown in Fig. 3a, where the armature is represented in the four successive quadrants of a single revolution, the black and white pole pieces representing the ends of the two coils in their different positions. The dotted lines indicate the position of a pair of resultant poles which must lie diagonally between the actual poles; this diagonal line represents the resultant polarity of the armature and it is evident that neither of its actual poles could be in a position of stable equilibrium while in line with the poles of the field; the resultant armature pole is therefore made to follow a changing field that moves through 180 degrees at each reversal of the current [illegible]

Lamp Lighting Schedule. — Moonlight System.

MARCH.

Day of Month	Light	Extinguish.	Number of Hours
	H. M.	H. M.	H. M.
1	**6 20**	5.30	11.10
2	**6 20**	5.30	11.10
3	**6 50**	5.30	10 40
4	**8.00**	5.30	9 30
5	**9 00**	5.30	8.30
6	**10.00**	5.30	7.30
7	**10.50**	5.20	6.30
8	**11.50**	5.20	5 30
9	12.50	5 20	4 30
10	1.40	5.20	3 40
11	2.30	5.20	2.50
12	3.10	5.10	2.00
13	3 50	5.10	1.20
14	4 30	5.10	0.40
15	No	light.	0 00
16	No	light.	0.00
17	No	light.	0.00
18	**6.40**	**8 40**	2.00
19	**6 40**	**9.50**	3.10
20	**6.40**	**11.00**	4.20
21	**6.40**	12.10	5.30
22	**6 40**	1.20	6.40
23	**6.40**	2.30	7.50
24	**6 50**	3 30	8 40
25	**6.50**	4.20	9.30
26	**6 50**	4.50	10 00
27	**6.50**	4.50	10 00
28	**6 50**	4.50	10 00
29	**6.50**	4.50	10.00
30	**6 50**	4.40	9 50
31	**6.50**	4.40	9.50
Total number of hours,			192 50

[illegible] good for the United States [illegible] calculated at one half hour [illegible] the time for extinguishment [illegible]

[illegible] the day on [illegible]

[illegible] shown by bold face type, [illegible]

CORRESPONDENCE.

New York Notes.

NEW YORK, Mar 28.—The mayor, since his election to the presidency of the Board of Electrical Control, has handled the business of that body with considerable vigor, and the position which he assumed at the meeting of the [illegible] such a strong confirmation of [illegible] to which he pledged [illegible] has called forth the [illegible] of the city.

[illegible] one in the history of the commissioners of electrical control, and the pro- [illegible] more genuine [illegible] since the new [illegible] nuisance was [illegible] position [illegible]

its rivals and unjustly discriminated against it." W. C. Trull, counsel for the board, moved on Tuesday before Presiding justice Van Brunt, in Supreme court chambers, to have the company furnish a bill of particulars. He thought that the complaint should specify which of the company's thirteen rivals had been favored, and in what streets they had been allowed to put up wires when the subways were ready. John Rottman, in opposing the motion, managed to repeat a good part of the company's tale of wrong, which has on two occasions previously been told in the same court. Judge Van Brunt took the papers, and decided yesterday that the United States Illuminating company must furnish the members of the Board of Electrical Control with a bill of particulars.

The action of Gov. Luce in the matter of Mrs. Friend and her colleagues in the electric sugar refining transactions has excited comment in this city. It will be remembered that the parties in question were arrested in Michigan. Gov. Luce, it seems, has ordered a stay of proceedings, and directed the sheriff of Washtenaw county to hold the prisoners and not turn them over to the officers from New York until another hearing is had. Next Monday is set for a rehearing. When President Cotterill was asked last night what this dispatch meant his opinion was that it was a very peculiar proceeding. He said: "They were all to be tried to-day on a writ of habeas corpus. To-night, however, I received a dispatch from our lawyer, which only mystefies me further. It said: 'Extradition papers held good by the court. Just received an order by the governor granting a rehearing of the requisition next Monday.' I am not sure that I rightly understand what this means. It appears to me to mean that the judge has dismissed the habeas corpus writ, but that the governor has decided before the prisoners are delivered up to give them an opportunity of another hearing before him Merely judging from what information I have, it looks like a strange proceeding after the judge of the Circuit court has decided the case."

William Bracken, president of the Julien Electric company of this city, gave some interesting testimony on Monday last before the committee on street railways of the Massachusetts legislature relative to the danger to life and property involved in the use of overhead conductors for electric street railways. He spoke of the general demand for underground wires both in Europe and America, and declared that the conduit system must finally be adopted. He read an affidavit of Elias E. Ries of Baltimore, the inventor of an electric railway system, stating at length that the overhead system was dangerous as well as unsightly, and that the dangers multiply as the number of cars increases, which he asserts is not true of the storage method. Mr. Bracken further submitted documentary evidence in support of his proposition that both alternating and continuous currents are dangerous to life when carried overhead. In regard to the alleged failure of the conduit in Boston, Mr. Bracken said the conduit system was doing much better than the overhead system was doing a year ago. The Julien company was running four cars on the Fourth and Madison Avenue line in New York. They were running only a few cars, but they were running them well, and in a way that vindicated the superiority of the storage system. The batteries in their cars weighed 3 400 pounds, and would run for six hours at a cost of 2 cents per car per mile.

The recent car strike, in spite of the inconvenience and loss that it entailed, seems to have been really serviceable in calling attention to many things which have hitherto been allowed pretty well to take care of themselves. Another example of this is afforded by the special report on the strike of Superintendent W Murray of the New York police force He says "I feel it incumbent upon me to urge the speedy adoption of the best and most serviceable police signal system, whether by telephone, telegraph or other approved method, in order that detailed information can be sent to and from the central office, or from the several station houses, with the greatest facility. The employment of policemen as messengers in time of riot or disorder not only uses much valuable time, but each messenger temporarily [illegible] from a place where, [illegible] are badly needed. A mob grows [illegible] and gathers [illegible] proceeds. Prompt [illegible] the police force to be rapidly [illegible] and it is of the [illegible] department should be provided [illegible] or that may [illegible]

[illegible] contribution which the [illegible] the Cornell univer- [illegible] for arc and incandescent [illegible] number of [illegible] The Edison company has also lately sent to Professor Roberts a fine collection of samples illustrating their standard makes of incandescent lamps.

A most interesting paper on "Lighting Cars by Electricity" was read by Dr. H. K. Waite on the 21st inst. at the meeting of the New York Railway club. The system of car lighting by the Julien storage battery was fully described and illustrated, and the paper was listened to with marked appreciation by the large company present. P.

Indianapolis, Ind.

INDIANAPOLIS, Ind., March 1.—The bill to repeal the telephone law of 1885 limiting rental charges to $3 for business houses and $2.50 for dwellings, passed the senate by a large majority, and has been signed by the governor. This action of the legislature has given general satisfaction throughout the state. In many towns and cities the service was abandoned, as the exchanges would not have paid expenses under the law, and those that were kept open did not give the service the public looked for and expected, though it was the best that could be given under the circumstances. It is the intention of the company to begin at once to restore and improve the service where it can be done. Many valuable improvements have been made since 1885; these will be added. There are still several bills before the legislature looking to the regulation of rental for telephones, but it is doubtful whether any of them will be acted on this session. During the session of the legislature of 1887 there was a bill, similar to the one that has just become a law, passed in the house, but owing to the deadlock in the senate over the lieutenant-governorship, it failed to receive attention from that body, although the sentiment of the majority was in its favor. M.

Detroit, Mich.

DETROIT, Mich., March 2.—A suit of considerable interest to telephone, telegraph and electric light companies was argued and decided in the Wayne Circuit court last week. A little over a year ago a building on Larned street, owned by Amos Chaffee, and occupied by Barnes Bros. as a paper warehouse, was destroyed by fire. At the time it was claimed that the firemen were impeded in their work on account of the number of wires strung along the alley, and consequently greater damage ensued. To recover Mr. Chaffee commenced suit against the Telephone & Telegraph Construction company, claiming $50,000 damages. The suit was brought up before Judge Reilly, and upon the offer of Mr. Kirchner, plaintiff's attorney, to introduce certain evidence, the defendant's attorneys, Messrs. Pond and Wells, objected. This raised the point upon which the case resulted in a verdict for the defendant. It was argued that there was nothing in the declaration of the plaintiff to presume that the company did not occupy the alley with its poles lawfully; that the alley was a public way, and the company had a perfect right to erect their wires. The fact that the wires were strung along the building was not, it was argued, the proximate cause of plaintiff's damages. The liability of the defendant for the destruction of the building was so remote that it could not be held legally liable. C.

New Orleans, La.

NEW ORLEANS, La., Mar 23.—The electric motor business in this city has been developing rapidly during the last year. J. B. Wolf & Sons and Max Frankel and others operate from twelve to eighty sewing machines by this means. There are, in addition to these, fourteen motors, which are used to run large freight elevators in this city. The presses of the *Daily States* and the *Daily News* are driven by motors. The Edison electric light business has also been brisk, and a number of oil and cotton mills, sugar houses and breweries have been fitted up with independent Edison plants.

Akron, O.

AKRON, O., March 2.—The Central Union Telephone company of Ohio has begun an action against the Sprague Electric Railway company of this place. The plaintiffs claim that the strong current of electricity on the railway overhead cables, by means of induction, is not only destroying their telephonic appliances, but that the noise from the car wire almost shuts out the voice over the telephone lines. The telephone company asks for relief and an injunction restraining the railway company from extending their tracks until the matter in dispute is settled. F.

St Louis, Mo.

ST. LOUIS, Mo., March 2.—The members of the council and representatives of the Lindell and Pine Street horse car lines, which were recently consolidated, on their return from Cleveland, where they inspected the Sprague system of electric street railroads, reported that they were favorably impressed with the workings of the electric system, and think it practicable. Councilman Blakely desires that some

overhead system be adopted in St. Louis. By special invitation Comptroller Campbell and Mayor Allen visited the southern portion of the Broadway Street railroad, where Short's overhead system is now in operation, and on their return stated that it was working admirably.

Referring to the reported compromise on Dempsey's telephone bill, by which it has been agreed to fix the maximum telephone rate at $75 per annum, George F. Durant, the manager of the Bell Telephone company of Missouri, said: "A compromise bill that would fix the maximum telephone rate at $75 per annum would be as ruinous to the business as the original bill, which proposes to fix the maximum rate at $50, for it would be utterly impossible under either rate to maintain and operate telephone systems. Our company would not accept the exclusive right for one century from the city of St. Louis to own and operate a telephone system here at the rate of $90 per annum per instrument. One hundred dollars per annum is the lowest possible rate at which the company can do business and still have a margin of profit, at present, and the tendency is in the direction of an increase of cost of operation. In New York city it has been found impossible to operate telephone plants at less than $100 per annum on account of the distances and other conditions which also are found in St. Louis. The conditions surrounding the telephone business are constantly changing. The underground plant is yet experimental. The limit of time such plants are expected at present to live is five years. Unless this time can be extended, a great loss in consequence must fall upon the companies. The telephone business is yet in an experimental stage. Improvements are rapidly being made and telephone plants are constantly undergoing modifications and changes. The expenses of these changes all fall upon the company, and so far they have been almost entirely in the line of improved service and not in the direction of reduced expenses. There is another feature about the business of telephoning that has a very important bearing, and which is exceedingly difficult to make plain to one who is not familiar with the mechanism of telephone systems—I mean the fact that each new telephone that is added does not proportionately lower the expenses of operation. Each telephone is an integral part of the whole system. Each new telephone up to a certain limit, about 3,000 at present, actually adds to the cost of operation because of the complications resulting. Inventions yet to be devised may make the operation of an unlimited number of telephones in one plant possible—not only possible, but economical; that is, the greater the number of telephones the cheaper the rates. That is certainly a consummation to be wished for, but which, unfortunately, has not yet been reached. In that particular the telephone business is different, I think, from any other." R.

Kansas City, Mo.

KANSAS CITY, Mo., March 2.—A system has been devised by W. W. Smith, general manager for the Missouri & Kansas Telephone company, which obviates nearly all the evil effects of induction in the telephone work of large cities at a trifling trouble and cost. The system is simple, and it is not known that it is in use at any other point. The induction from electric light wires had become very troublesome, and it was proposed to run a common return ground wire for instruments located in the same section of the city, just as was done in Richmond, Va., and in other places. Mr. Smith has omitted the return ground wire entirely, and has merely connected the ends of the subscribers' lines together instead of grounding them. About thirty is as small a number as can be satisfactorily connected together in this way. When the number gets much less one subscriber can sometimes overhear the conversation of others. As an induction remedy it is very successful. This method of obviating induction is being put into operation as rapidly as possible, and it is expected that within a month all the wires running into the exchange here will be connected as described. All those wires which use such connections will certainly receive attention.

General Manager Smith returned the other morning from Jefferson City, where he had been to watch the Dempsey bill. When seen Mr. Smith said: "I came up from Jefferson City an hour ago. I was in the house yesterday afternoon when the committee on municipal corporations reported favorably on the Dempsey bill, which fixes the telephone rate in cities of 100,000 or more at $48 per year. This bill will affect only Kansas City, St Louis and St. Joseph, but it has not gone through yet. It will have its three readings, and if it passes the house it may be killed in the senate. The chances are about even on its passage, and as yet nobody can tell what will become of it. If it goes through we will immediately close our service here, for I don't think the directors will stand one cent's reduction. A similar bill passed the Indiana legislature about four years ago. It closed up nearly half the companies in the state, and it has just now been repealed. The pa[illegible] gave the [illegible] name among [illegible] in more ways than one."

A [illegible] contract has been let for changing the motive power of the Vine Street dummy line [illegible]. Work will probably be commenced as soon as [illegible] will permit, and the line will be ready within [illegible] after that time.

Charles [illegible] has resigned his position as [illegible] ent of the Consolidated Electric Light company of Kansas City, Kan., and accepted his old position with the Hawkeye Electric Manufacturing company of Davenport, Ia. He will open an office in Kansas City soon.

Mr. Freidburg, president of the Kansas City, Kan., Consolidated Electric company, states that he will start with 5-30 light 2,000 candle power machines. An incandescent plant, alternating, will be put in soon. The Electrical Supply company of Chicago, through C. H. Cone, their Kansas City agent, furnished all the supplies for the construction of the modern plant, with the exception of boilers, engine, dynamos, and their auxiliaries. P.

THE ELECTRIC LIGHT.

Frostburg, Md., is to be lighted by electricity.

The streets of Monroe, Mich, will be lighted by fifty arc lights.

It is probable that an electric light plant will be installed at Jonesboro, Ark.

The town of Delphos, O., will probably purchase a Silvey plant for municipal lighting.

The new Edison station at Kansas City will probably be in operation about the 15th instant.

The Illinois Valley Electric Light & Power company has been incorporated at Ottawa; capital stock, $20,000; incorporators, C. I. Balland, Lewis Degen and N. E. Degen.

The Jefferson (Ill.) Rapid Transit Railroad and Electric Lighting company has been incorporated with a capital of $250,000. Incorporators, G. H. Parker, G. C. Thomas, S. S. Kimbell

The city of Galena, Ill., was lighted with electricity last week for the first time. The streets were illuminated with 100 incandescent lamps, which are to take the place of gas, heretofore used.

The Harvard Electric Light company of Harvard, Ill., has been incorporated; capital stock, $16,000; to furnish electric and other light and power; incorporators, W. Fay, E. D. Stiles and J. Eason

The Sperry Electric company, of Chicago, recently shipped a twenty-arc light Sperry dynamo and lamps, complete, to the Belvidere Electric Light company, Belvidere, Ill This makes the fifth Sperry dynamo the Belvidere company have added to their station.

An English paper, in speaking of the electric lighting system employed to illuminate the Hoosac tunnel, says: For long tunnels, such as the Mont Cenis and others, this method of lighting may prove sufficiently advantageous to be adopted for supplying light underground along the route.

The new Midland hotel of Kansas City is now running its own electric light plant. The United States system is used, the power being supplied by two Ide automatic high speed engines of 140 horse power. The engines are coupled together and arranged so as to be run together or independently. The work was furnished and erected by English, Morse & Co. of Kansas City.

Among the recent sales of the Thomson-Houston company of Chicago are the following plants: Faribault, Minn., 600 alternating lights; Nashville, Tenn., 50 incandescent lamps for use in waterworks; Spokane Falls, Wash. Ter., 50 arc lamps; Stockholm, Cal., 100 incandescent lights; Tootle Hosea, St. Joseph, Mo., 800 incandescent lamps; Bi-metallic Mining company, St. Louis, Mo, 250 incandescent lights.

It was noted recently that the station of the Fostoria, O., Electric Light company had been destroyed by fire. While the ruins were still red hot the company telegraphed for new machines. An interruption of only five nights' duration was caused, though the works were completely destroyed. The company is receiving general congratulations for its enterprise. Since the fire the city council has made a new contract with the company for lighting the city for a term of five years, at $5,000 per annum, the light to burn all night.

A telegram from Houston, Tex, says: The contract between the city of Houston and the Fort Wayne Jenney Electric Light company has been signed, and the work of putting up the poles has been commenced. Joseph P. Smith, the representative of the company, telegraphed his superintendent of construction to come right on. Two carloads of material have arrived, including ten miles of wire, which makes about fifteen cars of material now on hand. The contract with the present company expires April 15, and the new company will be in operation by that time.

The Thomson-Houston Electric company report the following sales: Rockland, Me., 30 arc light plant; Atlanta, Ga., 1,000 light alternating plant. Troy, O., 600 light alternating plant; Mobile, Ala., 500 alternating plant; Macon, Ga., 500 alternating plant; Woburn, Mass., 50 arc light plant; P. J. Noyes, Lancaster, N. H., 50 light incandescent plant, T. J. Stewart, Bangor Me., 50 light incandescent plant, H. W. Smith, Bangor, Me., 50 light incan-

[illegible]

THE ELECTRIC MOTOR.

[illegible]

[illegible]

[illegible]

The Abilene Street Railway company of Abilene, Kan., contemplates building a mile and a half more track, and will equip it with electric cars.

The City Passenger Railway company of Erie, Pa., contemplates constructing about twelve miles of electric road, to be in operation by June 1st.

The electric motors may now run at the rate of twelve miles an hour in Cleveland, O., an ordinance to that effect having been passed by the board of aldermen.

An electric railway from Negaunee to Ishpeming, Mich., three miles, is projected. Current will be generated at the falls, ten miles away, and transmitted by wires.

The Key City Electric Street Railway company of Dubuque, Ia., objected to filing a bond in the sum of $5,000 for the due construction of the proposed road, as required by the city authorities, and the desired franchise was not granted.

The Sprague Electric Railway & Motor company has been awarded the contract for supplying four motors to drive ventilating fans in the Rookery. Two of these will be 5 horse power, and the others will be 2 and 1 horse power respectively.

The Central Electric Railway company of Sacramento, Cal., has made arrangements to build its line. Work is to commenced in six months, and it is to be in operation within three months after completion. Five storage battery cars have been ordered.

William B. Sterling, president of the Huron (Dak.) Electric Light & Power company, announces that he has purchased an incandescent plant to operate in conjunction with the arc plant now in operation in that town. The *Huronite* says: "The new dynamo and other electrical apparatus, it is expected, will arrive the latter part of this week, and the work of putting in the lights will be pushed forward as rapidly as possible. This improvement will cost the company about $5,000, and when completed will make Huron one of the best lighted cities west of Chicago." The lights will be operated within thirty days, it is expected.

The Thomson-Houston company last week closed six contracts for electric railroads. That at Rochester, N. Y., has already been noted. Two roads will be operated at Kansas City—the Vine Street Railway company having four miles of track and six cars, and the Metropolitan Street Railway company having four and one-half miles of track and eight cars. At Omaha the Motor Railway company has ordered twenty cars, ten of which will have motors. This company has seven and one half miles of track. The Newton, Mass., circuit line, with 10 cars, and the Colerain Avenue Street Railway company of Cincinnati with eight cars and 3 miles of track, have ordered outfits.

THE TELEPHONE.

A dispatch from Springfield says: Representative Baker of Evanston had the house committee on judiciary consider his telephone bill March 1st, and after a protracted discussion it was made a special order for Tuesday next. In explaining its provisions he was bitter in his denunciation of the telephone companies. The chair decided that there was no quorum, and the further consideration of the bill was postponed until Tuesday, when Mr. Baker will present the figures which, he says, will convince his colleagues of the fairness of his bill.

The St. Louis *Republic* says: "George F. Durant of the Bell Telephone company, said that the capacity of the Bell Telephone company's new plant, to be built at the south east corner of Tenth and Olive streets especially for its use, would be 5,000 subscribers. The company does not expect, Mr. Durant says, to get into the new building until inside of two years. The intention, when the change is made, is to give every telephone subscriber in the city a metallic circuit. The company expects that by the time the St. Louis plant is in operation all the principal cities in America will be connected by telephone lines."

The official test of the Bell Telephone company's long distance telephone system was made February 19th between Buffalo, New York, Albany and intermediate points. A local newspaper says: A conversation with the metropolis was carried on most successfully. The line worked entirely free from induction, and the distinctness with which the voice could be heard at so great distance was surprising. Conversations with Boston, Syracuse and other points were carried on successfully. The company has fitted up their rooms at 14 West Seneca street with three compartments for the convenience of patrons, who can thus carry on conversations in strict privacy.

Miscellaneous Notes.

The [illegible] the White Star line, [illegible] fitted throughout with electric light, electric bells, electrical gear in connection with steering and signaling, electric search lights and other electrical appliances of the most approved description.

The Electro-Optic Manufacturing company has been in[illegible]rated at Chicago, with a capital stock of $10,000, for the manufacture of electrical, optical, chemical, medical, [illegible] machines and appliances. The incorporators are G. B. Reynolds, H. C. [illegible]

Personal Paragraphs.

A. R. Foote of the Queen City Electric company of Cincinnati was in Chicago last week.

Elmer A. Sperry, of Chicago, who was called east by telegram during the convention to attend the funeral of his father at Cortland, N. Y., returned home last week.

Mr. Edison on his forty-second birthday, February 11th, was presented a $2,000 outfit of laboratory conveniences by the present and a few of the past workers in that department.

Thomas Addison, formerly connected with the Chicago office of the United States Electric Light company, has accepted a position in the Chicago office of the Thomson-Houston company.

D. P. Perry, vice-president and general manager of the Sperry Electric company, Chicago, has been seriously ill and was confined to his room last week, having contracted a severe cold at the Exposition building during the convention of the Electric Light association.

John H. Reid, manager of the Chicago office of the Mather Electric company, and Miss Lillian A. Smith of New York city, were married Sunday, March 3d, at 245 Erie street, Chicago. The wedding was attended by many friends of the contracting parties, and many substantial and elegant tokens of esteem were received. The couple visited St. Paul and other western cities on their wedding trip.

Business Mention.

The Knapp Electrical company, Chicago, last week shipped a large consignment of wire to San Francisco, Cal., and another to St. Paul, Minn., both to be used by the Mather Electric Light company in wiring hotels and flats for electric lights.

The Central Electric company of Chicago has secured the western agency for the new Cleveland double-pole switch, which has just been placed on the market. It is an application of the same principle as the old Cleveland single-pole switch, the only difference being that it is a double make and break.

The Heine patent safety boilers are gradually gaining a strong foothold among intelligent steam users. Repeated tests have demonstrated them to be highly economical. The western agents, Messrs English, Morse & Co. of Kansas City, Mo., report business good, and among recent sales mention a 300 horse power Heine for the Armour Packing company, which is the second order received from this company. The firm will be pleased to mail circulars of this boiler and correspond with anyone requiring economical boilers.

The Ball Engine company of Erie, Pa., invite attention to their high speed automatic cut-off engines, which are especially adapted for electric light purposes. These engines are built of the very finest material, and the workmanship is of the best. The efficiency and fuel economy are the best attainable for an engine of its type, and maintains this high grade of economy for a longer period of time than any form of piston-valve engine. The regulation, as a result of the principle embodied in its governor, is better than has ever been realized by any other system of [illegible]ning. No matter whether the engine is loaded or empty, and whatever the boiler pressure may be, the speed [illegible]ary. Catalogues will be sent on application.

The Rose Polytechnic Institute of Terre Haute, Ind., is [illegible] the United States which [illegible] mechanical and electrical engineers. It owes its existence to the gen[illegible] Terre Haute, who be[illegible] for its establishment [illegible] of the techno[illegible] opened in the [illegible] of the institute is [illegible] of the students [illegible] machines de[illegible] actual constru[illegible] work. [illegible] In [illegible] appliances [illegible] the [illegible] Wm. [illegible] [illegible] of [illegible]ommercial instruments. An[illegible]

will not char or carbonize. Asbestos is that substance which will withstand heat to a greater degree than any other known material, and is also a superior insulating substance, but in its natural state it presents the difficulty of absorbing moisture, which destroys its insulating qualities. This difficulty heretofore has never been overcome. The present material is a light-colored, hard, bone-like substance, consisting of asbestos, with its pores entirely satisfied and filled with a chemical compound, which is vitreous in its character, thoroughly indestructible by heat, and possessing no element of carbon. Asbestos thus saturated will not absorb moisture, and will preserve its insulating qualities under every atmospheric condition, presenting nearly all the qualities of glass, and at the same time it may be stamped, turned, and otherwise mechanically formed into any shape desired. This insulation is especially applicable for use upon armatures, fields, insulating joints, washers for dynamo and motor work, washers and magnet ends, the insulation required upon rheostats which are liable to high temperatures, and in the manufacture of resistance coils for heavy currents no other insulation should be employed. Generally speaking, it is a complete substitute for mica, and where vitrified asbestos insulation is used upon converters, commutators, and the like, its employment is found to operate in a highly satisfactory manner. It looks in every way like a serviceable insulation, and one that will not be affected by temperature or moisture, which is certainly something new, and something that is wanted by every manufacturer.

Electrical Patents.

Issued February 26, 1889.

398,402. Current Collecting Device for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

A grooved wheel carried by the car makes traveling contact with the suspended conductor; the wheel and conductor may be moved vertically to compensate for any variations in the parallelism of the line conductor. The weight of the conductor is employed to insure proper contact.

398,409. Electrode for Secondary Batteries. Edward M. Lang, Falmouth, Me.

The electrode consists of fine threads of lead compressed into the desired form.

398,420. Electric Burglar Alarm. Laurence A. McCarthy, Brooklyn, N. Y.

398,441. Telegraph Cable. William R. Patterson, Chicago, Ill.

The core of insulated conductors is bound together and covered by an impervious sewing, lead tape being the preferable material. The core thus formed is drawn into a lead pipe, and the annular space between the inside of the pipe and the core is filled with coal tar, paint, or similar material.

398,442. Telegraph Cable. William R. Patterson, Chicago, Ill.

The cable consists of an unsewed core of separately insulated conductors, slightly and loosely twisted together. This core being inclosed in a pipe, after which a filling of insulating material is forced into the pipe among and around the conductors of the core, the insulating filling becoming solidified when cold like paraffine.

398,457. Alternate Current Electric Motor. Oliver B. Shallenberger, Rochester, Pa.

The object of the invention is to provide a motor which will start readily from a state of rest, and gradually increase its speed until it reaches a maximum dependent upon the rate of alternations of the electric current. The last claim reads:

"5. The combination, with a source of alternating, intermittent, or pulsatory electric currents and a circuit therefor, of an electric converter, having its primary connected in said circuit, a revolving armature having its coils connected in the circuit of the secondary coil of the converter, a second converter connected with said source of currents, a field magnet applied to the armature included in the secondary circuit of the second converter, and a rectifying commutator interposed in said secondary circuit between the field magnet and the converter."

398,458. Alternate Current Electric Motor. Oliver B. Shallenberger, Rochester, Pa.

The object of this invention is the same as No. 398,457.

The third claim is as follows:

"The combination, with the field magnet coils of an electric motor, of a converter having its secondary circuit connected through said coils, a second converter assisting in effect the first named converter, connections through the armature of the motor independent of the field magnet connections, and means for cutting the primary coil of the second converter out of circuit."

[illegible] Support for Electric Railway Wires. Thomas H. Brady, New Britain, Conn.

[illegible] Conductor for Electric Railways. Olof Dahl, Brooklyn, N. Y.

[illegible] Electric Switch. Warren S. Hall, Boston, Mass.

[illegible] Electric Switch. Franklin A. Weller and Adolph [illegible], Me.

The switch is of the class known as double-pole [illegible] and is designed for use with electric light [illegible]

[illegible] Electric Switch. Franklin A. Weller and Adolph [illegible]

[illegible] of the double pole class, and designed [illegible], the claims being limited [illegible] details.

398,566. Electric Cut-Out. William H. S. Wright, Kansas City, Mo.

Claim 1 follows:

"An electric cut-out comprising two wires joined by a fusible connecting rod and an inclosing insulated transversely divided case, whereby when the fusible rod melts, the wires are prevented from forming a ground connection."

398,577. Electric Brake for Railway Trains. Alexander H. Bowman, Packerton, Pa., and Watson P. Widdifield, Uxbridge, Ontario, Canada.

The third and sixth claims are given:

"3. In a system of electric brakes for railway trains the combination, with the friction pulleys of the brake, of a collar upon which the said pulleys press, the said collar consisting of alternate rings of fibrous substance, as wood and metal.

"6. In a system of electric brakes the combination of a friction pulley adapted to be brought in engagement with the axle of the car-wheels, a lever for applying the pulley to the axle, an elastic arm for the said lever, a solenoid, and a rod connecting the said elastic arm to the core of said solenoid."

398,613. Electrical Railway Signal. Horace Hayden, jr., and William F. Z. Desant, New York, N. Y.

The object is to provide a signal in the cab to indicate automatically danger, provided a preceding train has not passed off the section or block.

398,614. Quadruplex Telegraphy. Clarence L. Healy, Brooklyn, N. Y.

Claim 1 reads:

"In telegraphs, the combination, with a line, of a dynamo or other source of electrical energy grounded at one pole, a ground through resistance from the other pole of the dynamo, a direct line connection from the latter pole of the dynamo through the balancing resistance, a shunt-line connection from an intermediate point on the grounded resistance, and a key placing the direct and shunt connections alternately to line."

398,661. Insulating Support for Electric Conductors. Sidney H. Short, Columbus, O.

398,662. Electric Railway. Sidney H. Short, Columbus, O.

The invention consists, speaking generally, in a main conductor and generator, a guard wire, including a source of electrical energy, forming a normally open circuit and a controlling resistance connection between the guard wire and the generator, whereby the pressure on the main conductor is automatically controlled.

398,663. Switch Mechanism for Electric Railways. Sidney H. Short, Columbus, O.

Claim 3 follows:

"In combination with an electrical conductor and a generator, a guard wire arranged in proximity to the main conductor, forming a normally open circuit, a source of electrical energy, a controlling resistance connection between said guard wire and the generator for reducing or controlling the pressure in the main conductor, and a signaling device operated by the closing of the guard wire circuit."

398,668. Regulator for Dynamo Electric Machines. Elmer A. Sperry, Chicago, Ill.

398,713. Stock Indicator. John A. Enos, Boston, Mass.

398,731. Electrical Bathing Machine. Jack W. James, Cuba, Tenn.

398,737. Mercury Holder for Battery Zincs. William P. Kookogey, Brooklyn, N. Y.

398,744. Magnetic Regulator. Samuel E. Nutting, Chicago, Ill.

The invention relates to automatically regulating the amount of magnetism in the pole pieces of a dynamo electric machine, and thereby the strength of the currents to the requirements of the circuit.

The first and last claims are given:

"1. In a dynamo electric machine or motor, an automatic governor moving toward the pole pieces by the attraction of their magnetism against a resistance which increases more rapidly than said attraction, and diminishing the action of the pole pieces on the armature as it approaches them, the planes of the governor and the pole pieces being parallel, and the distance between them being variable, according to the varying attraction of the magnetism.

"7. In a dynamo electric machine or motor, the combination of an automatic governor moving toward the pole pieces by the attraction of their magnetism against a resistance which increases more rapidly than such attraction, a spring retractor, and an arm connecting the governor with the spring retractor, whereby as the magnetism diminishes the retractor withdraws the governor from the pole pieces, the planes of the governor and the pole pieces being parallel, and the distance between them being variable, according to the varying attraction of the magnetism."

398,769. Electric Circuit Coupler. Stanley C. C. Currie, Philadelphia, Pa.

398,774. Incandescent Electric Lamp. Thomas A. Edison, Menlo Park, N. J.

The invention is designed to prevent the formation of an arc between the terminals of the conductor within the globe of an incandescing electric lamp. This is accomplished by interposing between said terminals an insulating body, preferably of a transparent material like mica or glass.

398,794. System of Synchronizing Electric Motors. Francis J. Patten, New York, N. Y.

398,805. Gas Extinguisher. Adam Steinhilber, New York, N. Y.

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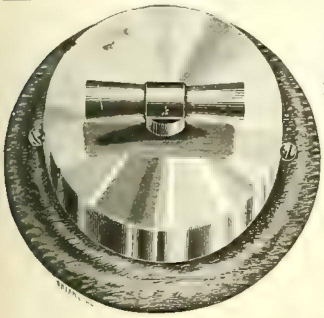

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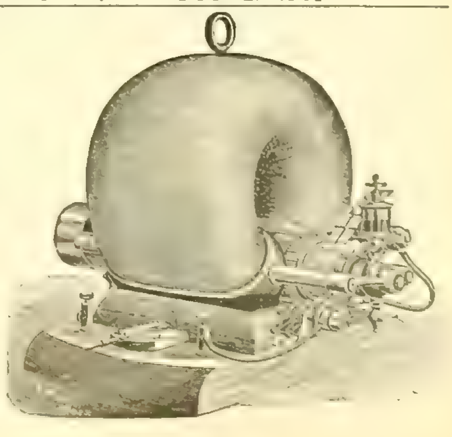

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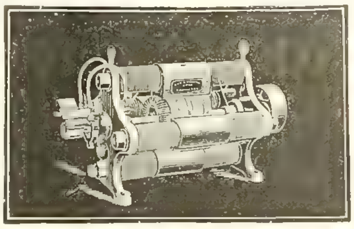

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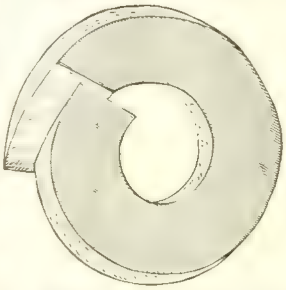

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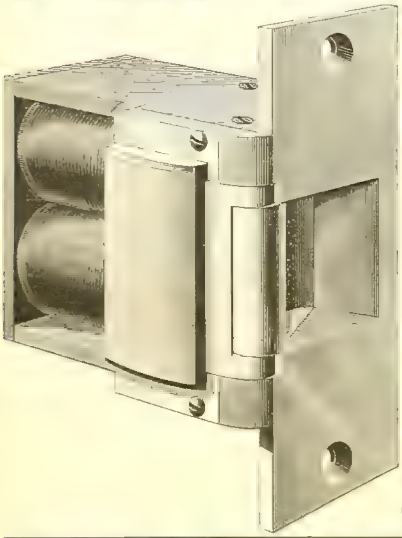

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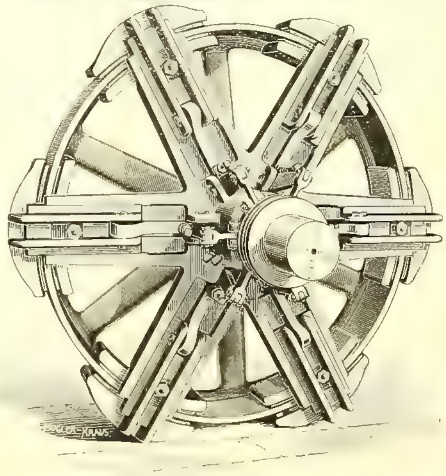

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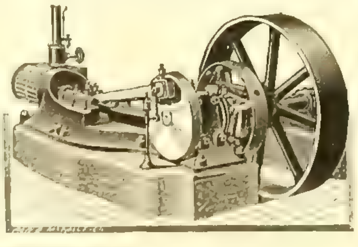

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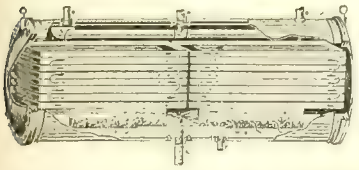

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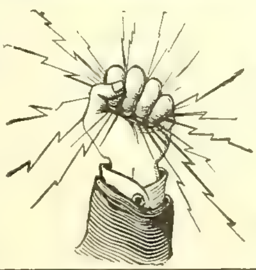

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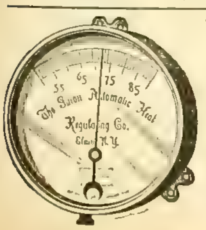

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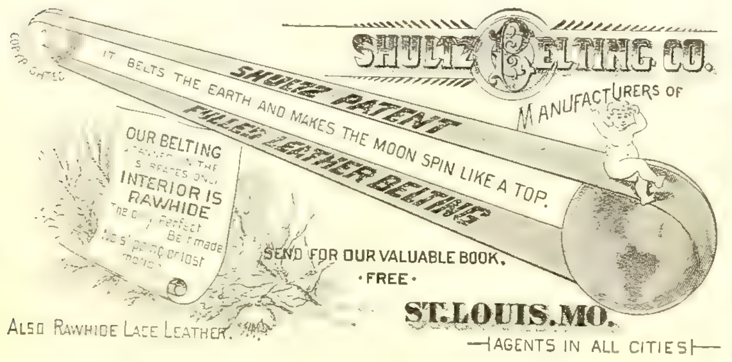

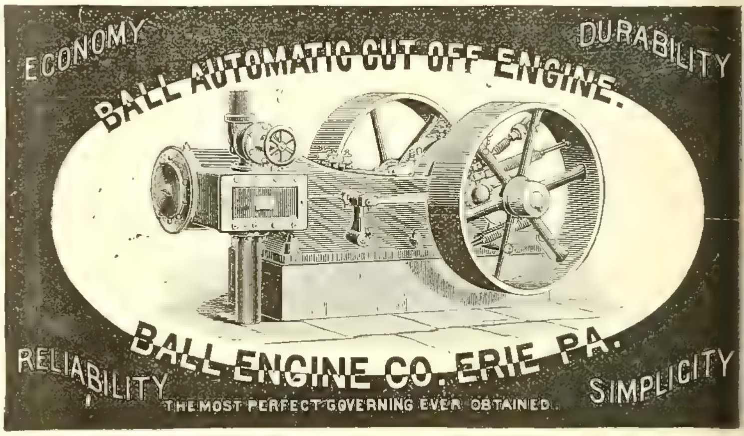

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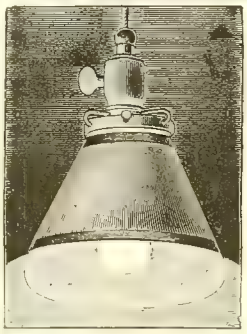

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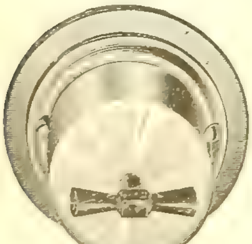

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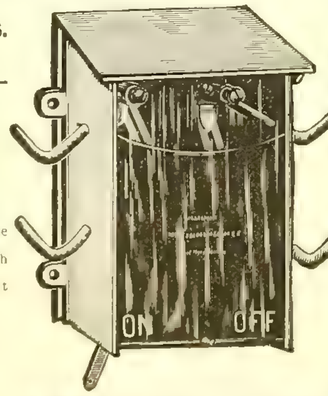

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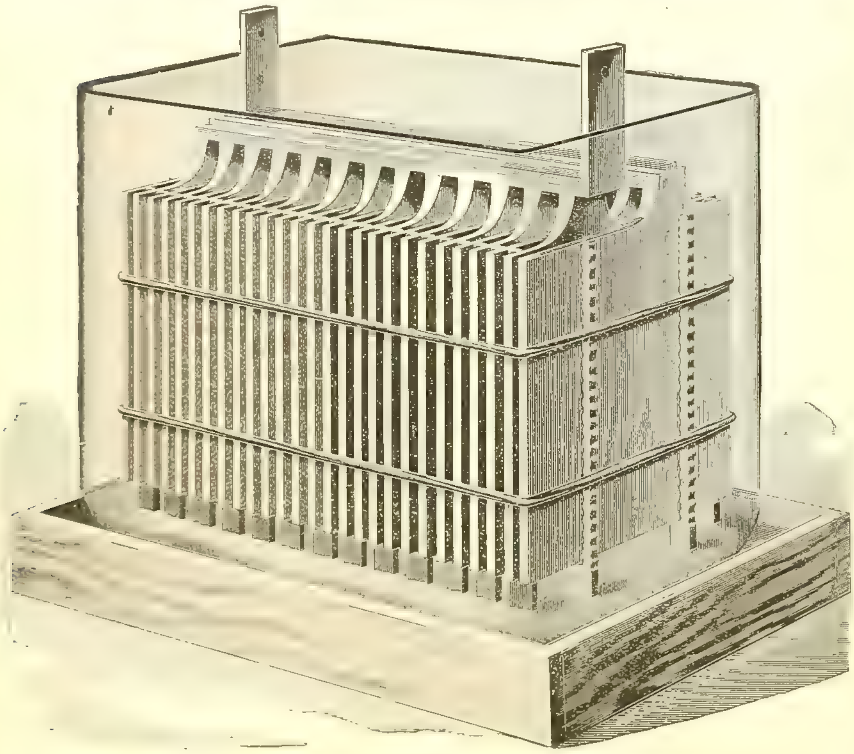

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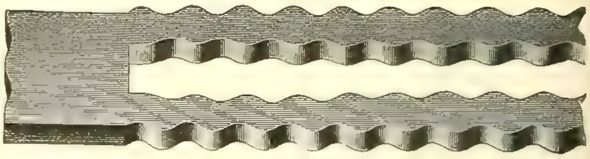

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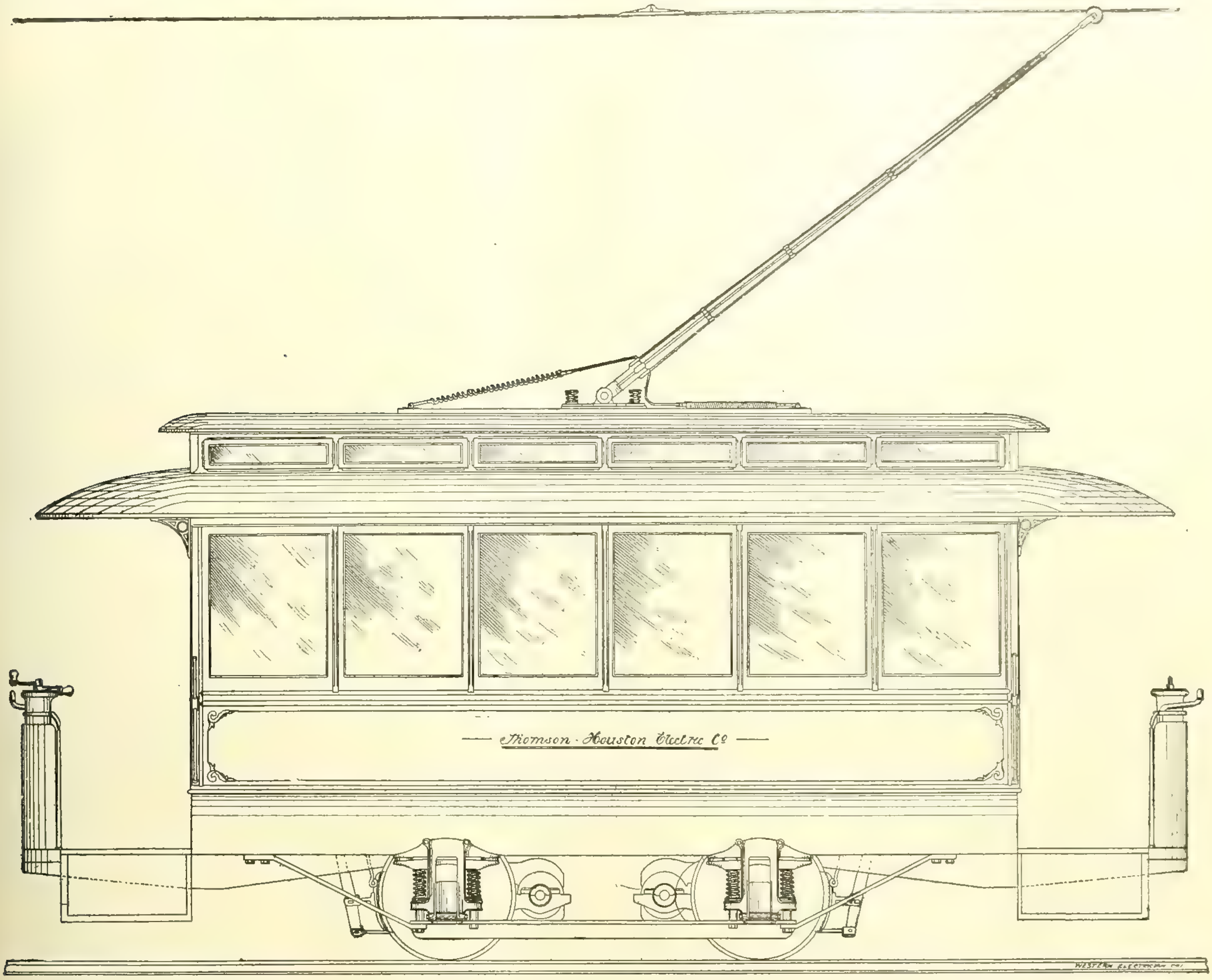

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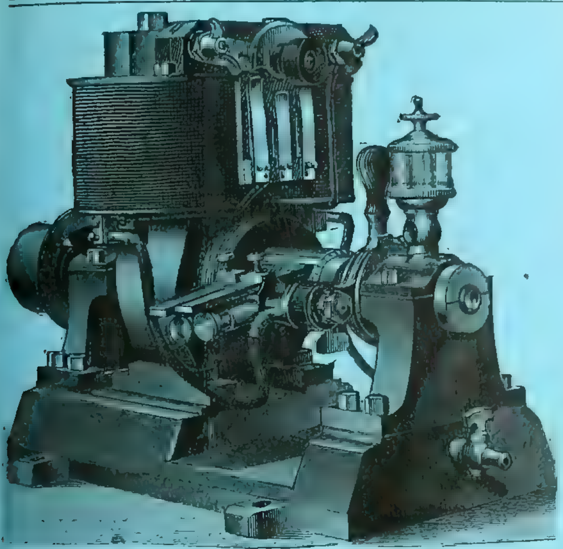

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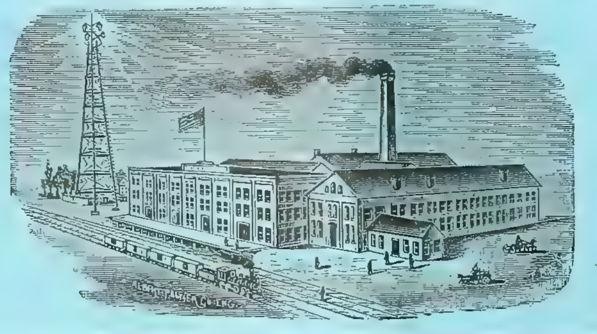

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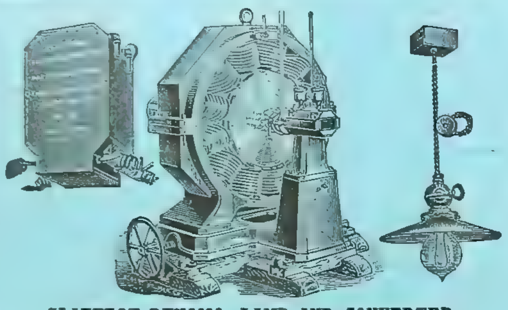

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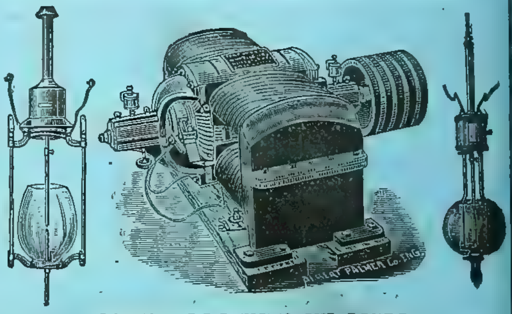

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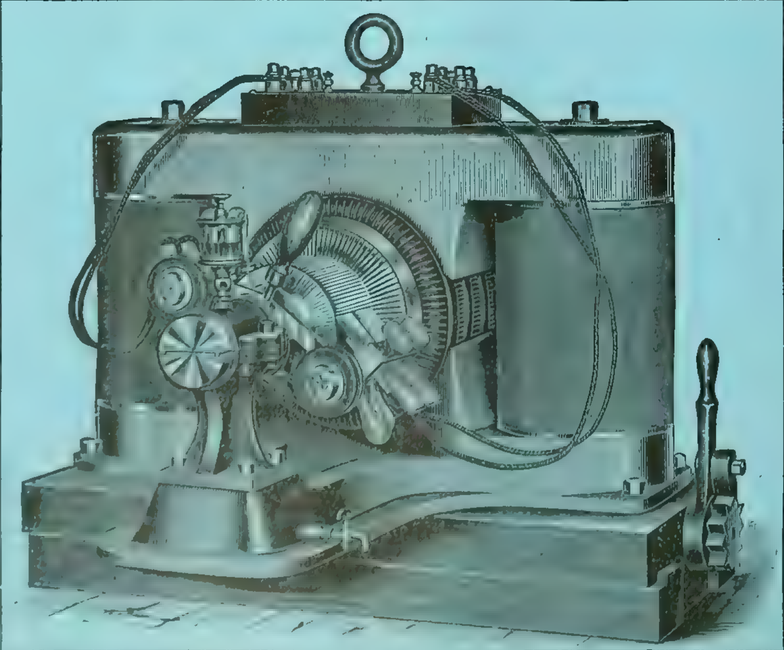

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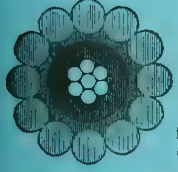

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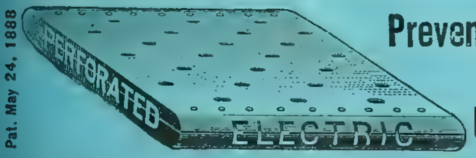

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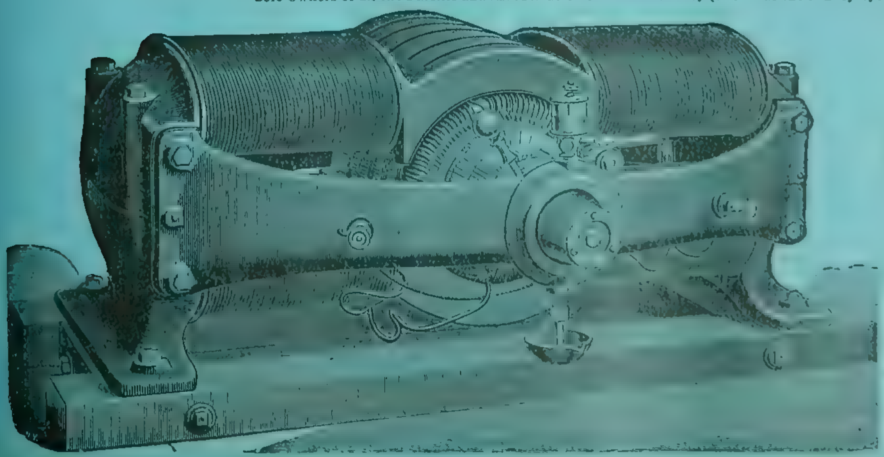

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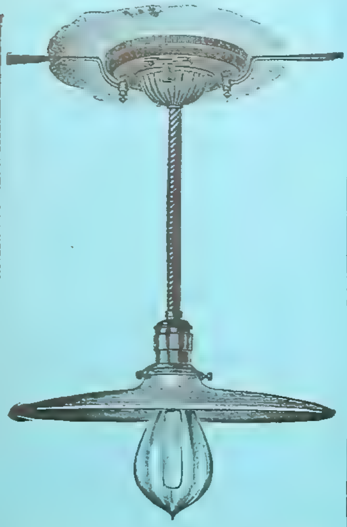

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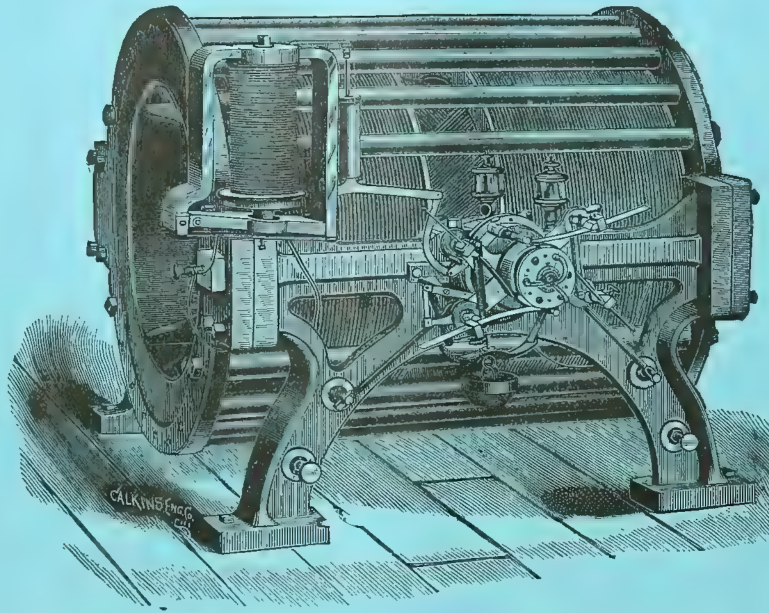

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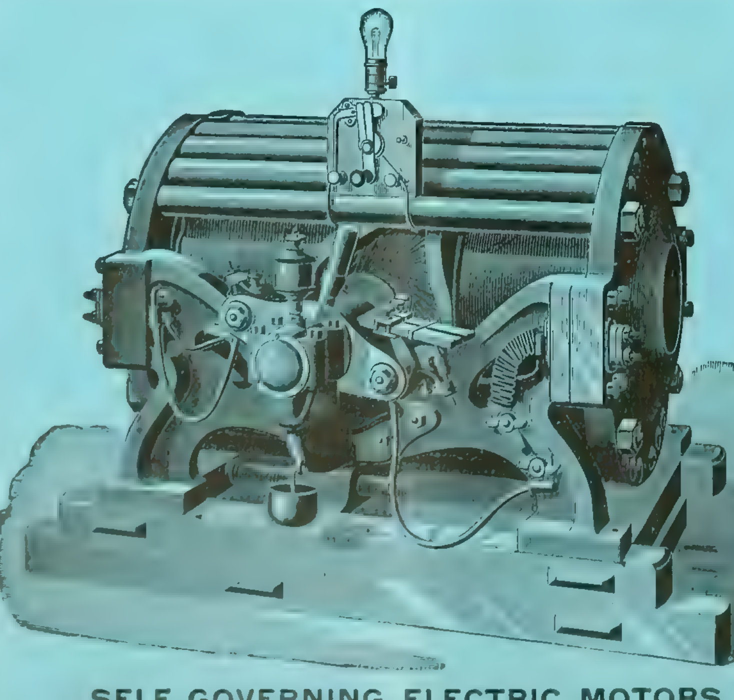

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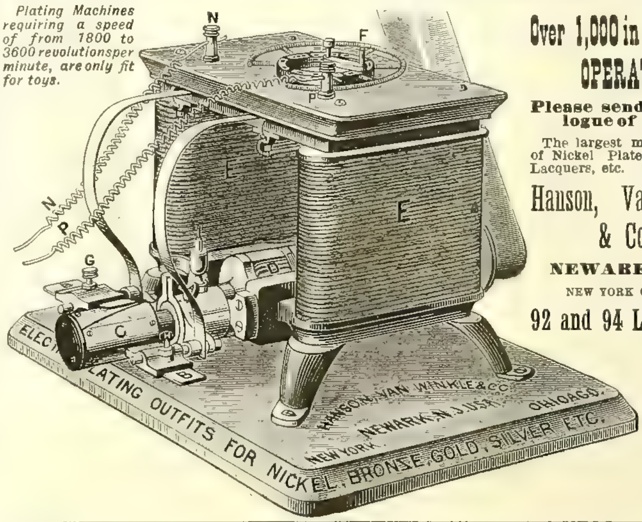

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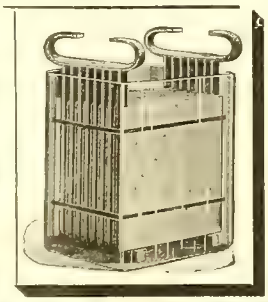

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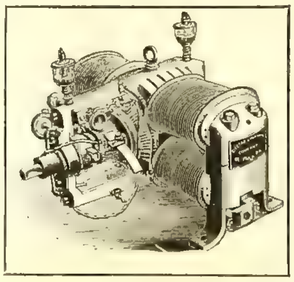

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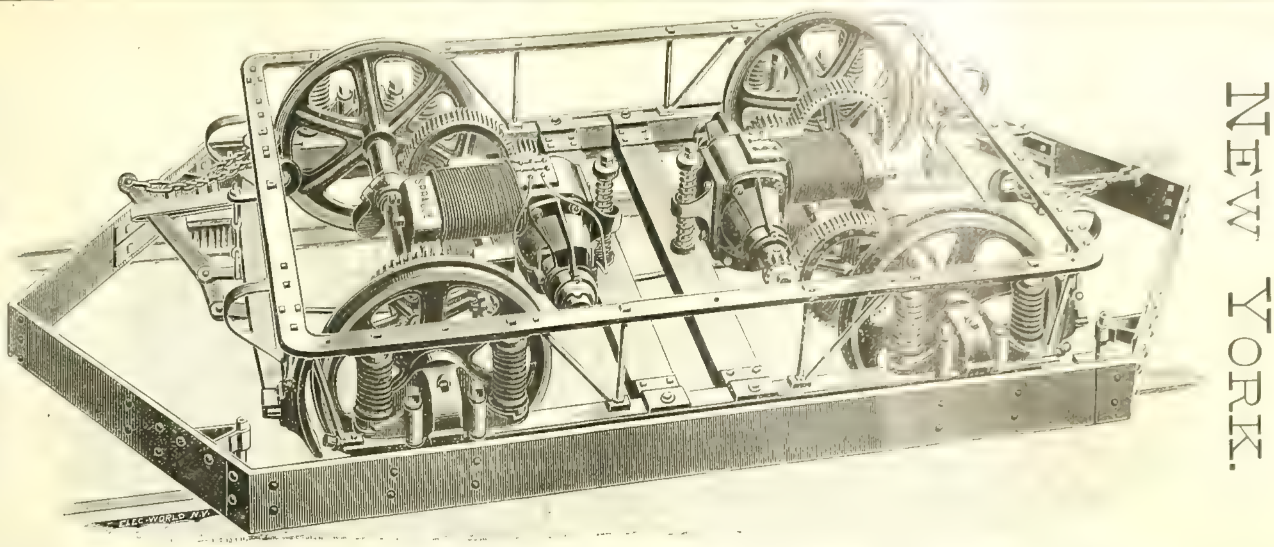

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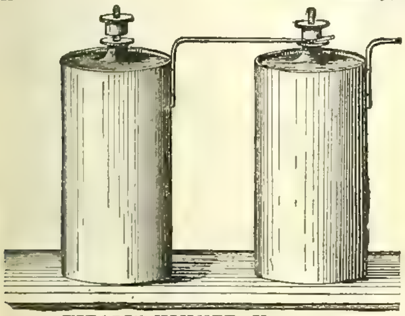

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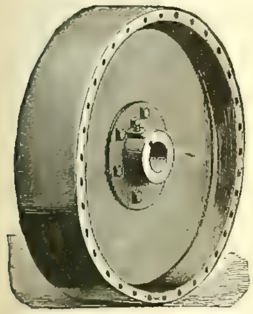

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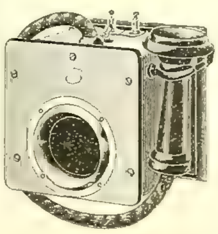

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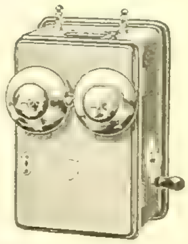

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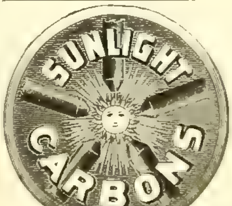

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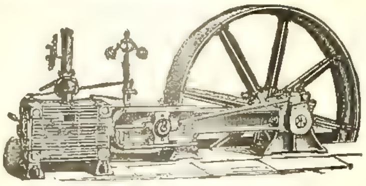

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SUSTAINING THE EDISON PATENTS

In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor ?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

Thus the QUESTION OF LAW having now been settled by the Supreme Court of the United States, and the QUESTION OF FACT by the highest experts of the world, this company now notifies the Public of its intention to call a halt and demand a reckoning for the trespass and abuse of its rights in

INCANDESCENT ELECTRIC LIGHTING.

EDISON ELECTRIC LIGHT CO.,

16 AND 18 BROAD ST., NEW YORK. *By EDWARD H. JOHNSON, President.*

THE

WESTINGHOUSE ELECTRIC CO.,

PITTSBURGH, PA.

THE PIONEERS IN INCANDESCENT LIGHTING

BY

ALTERNATING CURRENTS

AND OWNERS OF

FUNDAMENTAL PATENTS PERTAINING THERETO.

COMPLETE CENTRAL STATION OUTFITS.

Alternating Current Apparatus,

Direct Current Apparatus,

Arc Lighting Apparatus,

Electric Motors,

Electric Meters.

150 CENTRAL STATIONS IN OPERATION. 150

OFFICES IN ALL LEADING CITIES.

THE

WESTINGHOUSE ELECTRIC CO.,

PITTSBURGH, PA.

—LESSEES OF—

THE UNITED STATES ELECTRIC LIGHTING CO.

Sales Department, 120 Broadway, NEW YORK.

Arc and Incandescent Apparatus

—FOR—

ISOLATED LIGHTING.

Efficient Apparatus!

Economical Lamps!

Ingenious Devices!

THE SAWYER-MAN ELECTRIC CO.,

510 West 23d Street, NEW YORK.

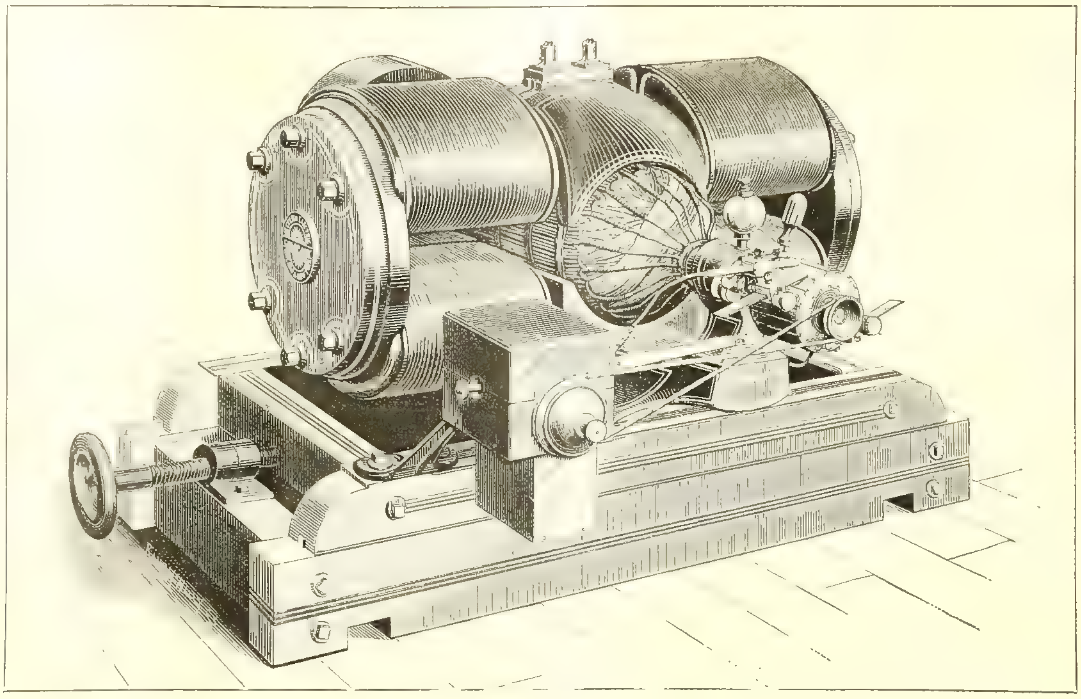
Incandescent Electric Lamps

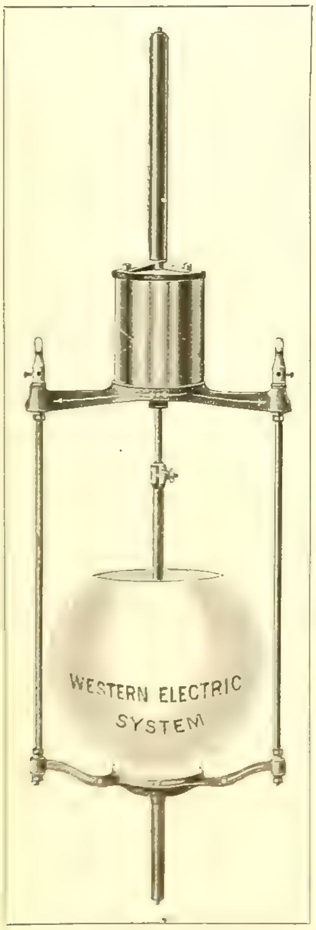
—AND—

SUPPLIES FOR ELECTRIC WORK.

ELECTRIC AND COMBINATION FIXTURES.

CORRESPONDENCE WITH DEALERS INVITED.



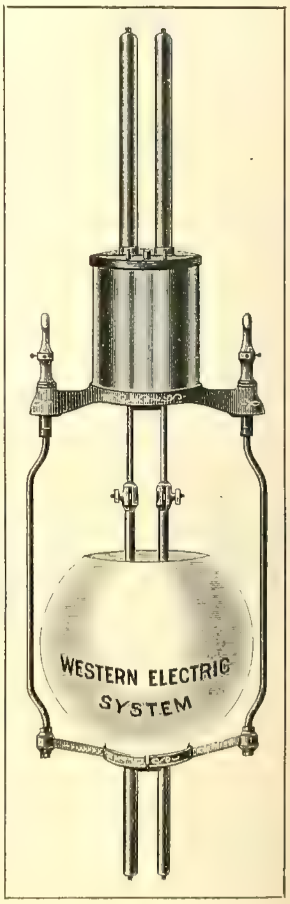


HIGH AND LOW TENSION SYSTEM

OF

Arc Lighting.

COMPLETE IN EVERY RESPECT.



PRICES UPON APPLICATION.

WESTERN ELECTRIC COMPANY,

CHICAGO. NEW YORK. LONDON. ANTWERP.

Western Electrician.

EVERY SATURDAY.

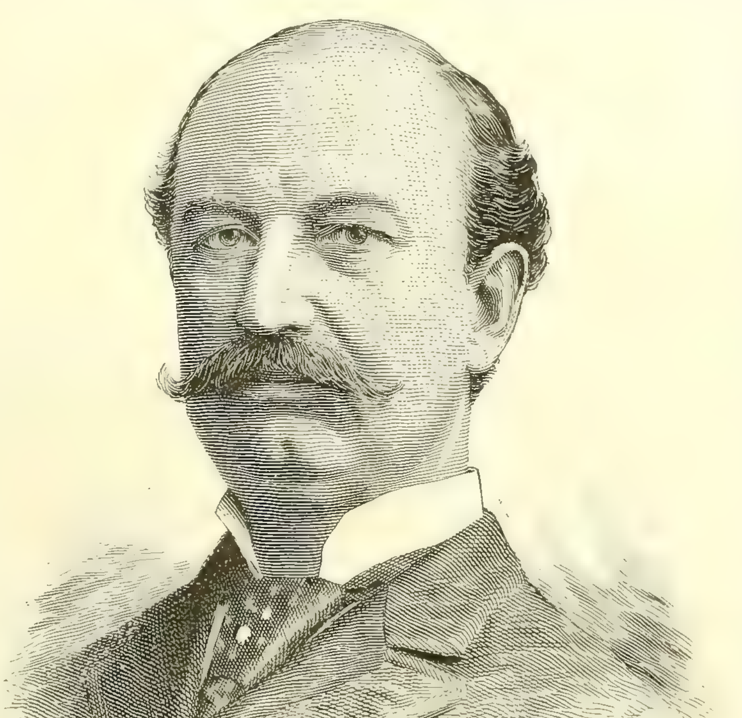
Vol. IV. CHICAGO, MARCH 16, 1889. No. 11

S. A. Barton.

Among those prominently identified with electric lighting in the west few are more widely known than S. A. Barton, president of the Chicago Electric club, whose portrait is herewith presented. Mr. Barton was chosen president of the club at the last annual meeting, and on assuming the position stated that he thoroughly believed in a broad policy for the organization. He thought the membership should not be less than that of similar organizations elsewhere, and deemed it essential that more pretentious quarters for club rooms should be secured. The changes which he advocated have not yet been made, but within a short time Mr. Barton's suggestions will undoubtedly be adopted, and the club will have rooms much better adapted to its needs.

Mr. Barton came to Chicago only two years ago from the east, where he is known and respected not only by the electrical fraternity, but by men in all branches of business and professional life. He was born in Ware, a small town in Massachusetts, and his first business experience was in the boot and shoe line. Later he engaged in the crockery business in Boston and Lynn, and established an excellent trade. He served in a Massachusetts regiment during the war, and has an honorable record as a soldier. He entered the service in April, 1863, and was mustered out at the expiration of the war in September, 1865. He was not 19 years of age until the following December.

Mr. Barton's experience in electric lighting has been remarkable. While engaged in business in Lynn his attention was attracted to the subject. He had occasion to call upon Prof. Thomson to light a large building to be erected by the G. A. R., in which a Masonic convention was to be held. So successful was the experiment that Mr. Barton deemed the new system practicable. He succeeded in interesting others in the scheme, and finally purchased the patents of the American Electric company of New Britain, Conn., which had been in operation since July, 1880, under patents of Prof. Elihu Thomson. He experienced much difficulty in organizing a syndicate to take the patents and invest the money necessary to push the business. Convinced of the practicability of the scheme, he persisted and finally succeeded, afterwards closing out his business at Lynn and investing all he possessed in the enterprise which was called the Thomson-Houston company. The company was organized in New Britain, Conn., with a capital stock of $125,000. Mr. Barton was chosen general manager, and has ever since retained that position, devoting his entire attention to the enterprise and displaying rare ability in the management of its affairs. The works were soon transferred from New Britain to Lynn, where an unpretentious factory was opened and fifty men were employed. The company has been uniformly successful. It has advanced rapidly under the judicious management of Mr. Barton, who has been assisted and encouraged by an able and judicious board of directors. The board to-day is the same that was appointed at the inception of the enterprise, and the members have co-operated with Mr. Barton since the organization of the company. New buildings have been erected from time to time, new branches have been added, and to-day the company has probably the most extensive factories in the world. It employs 1,600 hands and manufactures everything in the line of electric lighting, electric railways and stationary motors. The capital stock has been increased several times, and by a recent amendment of its charter by the Connecticut legislature, will soon be raised to $15,000,000, paid in capital. The original shares were sold at $25, and now easily bring over $300 in the market. The shipments based upon the present business done per month, if continued, will aggregate over $5,000,000 per annum.



S. A. BARTON.

The success which has attended the career of this company is due in a large measure to the efforts of Mr. Barton, who is an unassuming gentleman, courteous to all. His success is well merited, as is also that of the company under his broad, liberal and energetic management.

St. Louis Electric Light Contracts Awarded

After a thorough examination of the several systems represented, and after ten days of figuring on the bids submitted by the five companies that proposed to light the streets, public buildings and parks of St. Louis, in accordance with the plans and specifications adopted by the board of public improvements, the special committee on electric lighting made its report Saturday, March 9th, and the contracts were awarded. The contract for the southern district was awarded to Charles Sutter for arc lighting amounting to $84,780.50, and the Missouri Electric Light & Power company for incandescent lighting at $50,525. In the northern district Charles Sutter was also successful, securing the arc lighting for $81,659, while Charles A. Brown secured the incandescent lighting at $33,327.80. Mr. Sutter represents the Indianapolis Jenney system, while Mr. Brown represents the Western Electric system of Chicago. The total cost of lighting the city will be $250,292.30, $135,305.50 being for the southern district, while $114,986.80 will be for the northern district.

Edison Patents in Canada.

A dispatch from Ottawa, Can., says: The incandescent electric lighting patent held by the Edison Electric Light company has been declared null and void in Canada, on the ground of failure to comply with the patent regulations, which provide that the article thus patented must be manufactured in Canada within one year from the issue of the patent, and the importation of the same patent from the United States must cease within two years. This is the decision reached in the famous patent suit by Richard Pope, commissioner of patents.

A dispatch from New York states: Edward H. Johnson, president of the Edison Electric Light company, says the company will take the case to the Canadian court of appeals.

Chicago Telephone Rates.

The Illinois legislature has been considering numerous bills of late providing for the regulation of telephone rates throughout the state. The Eckhardt-Baker bill passed the senate, and was favorably considered by the house committee. It is not expected that the bill will be reached, however, as there are about 150 measures ahead of it, it is said, and a two-thirds vote will be required to advance it for a special position in the house. This vote, it is claimed, cannot be secured, and it is doubtful if the bill can be passed if presented.

Electric Light Station Burned.

The electric light station at Joplin, Mo., was destroyed by fire last week. The fire started among rafters in the dynamo room, and was caused by overheated steam pipes. The dynamo building and its two machines were entirely destroyed. O. R. Moffitt, who was operating the plant, immediately made arrangements to replace the burned building with a brick structure, and hopes to have his plant in operation at an early day. The Thomson-Houston company of Chicago has received an order for a 100-arc light plant, dynamos, engines, etc., and will ship them at an early day.

Chicago Electric Club.

The regular meeting of the Chicago Electric club was held March 4th. C. C. Haskins presided. The report of the committee which had charge of the entertainment in honor of the visiting members of the Electric Light association was presented, showing that after the payment of all bills a small balance would be left. The report was accepted, and a vote of thanks was given to the members of the committee for the efficient manner in which they had discharged their duties. After the transaction of routine business, Dr. A. DeBausset presented the subject of aerial navigation. He began by stating that inflated balloons had proved a failure, owing to the fact that gas was so easily affected by changes in temperature. The contraction or expansion of the gas made it impossible to keep the inflated balloon under control. Cases in which aeronauts had lost their lives were cited in support of the position which the speaker assumed. Dr. DeBausset described somewhat at length the air ship which he proposes to build. It will be, he said, about 640 feet long, and 140 feet wide. It will be a cigar-shaped cylinder, and will be built of steel, braced within with a light but strong framework, so that it will withstand the pressure of the air. Dr. DeBausset proposes to exhaust the air from [illegible] by means of pneumatic pumps. The ship, he says, will then displace enough air so that it will float. To the cylinder is attached [illegible] passengers, all the [illegible]sary machinery and fifty tons of freight. Dr. DeBausset proposes to utilize storage batteries [illegible] motive power. He pro[illegible] to travel about four or four and a half [illegible] earth, so that he [illegible] atmospheric dis[illegible]. The [illegible] would be [illegible] a wind blowing at [illegible] per hour. He would [illegible] the boat in the [illegible] he would be [illegible] thirty to fifty [illegible]ion followed, in which Dr. DeBaus-et answered a number of questions [illegible] of the air ship. [illegible] feasible, and had [illegible] the most eminent [illegible]. The cost of con[illegible] about $1,50[illegible]. He [illegible] that congress would pass the bills giving him the necessary funds to construct his ship.

The next meeting of the club will be held March 18th. On that evening George Cutter will read a paper on "Practical Suggestions about Handling Electric Light Circuits." An arrangement has been made by which a supply of current will be secured from the circuits of the Chicago Arc Light & Power company, so that all the points will be practically illustrated. Those who are interested in the subject are in[illegible]ted to be present, whether they are members of the club or not.

SPRAGUE ELECTRIC ROAD AT DAVENPORT.

The Oglethorpe Electric company has been formed at [illegible], with a capital of $[illegible], and privilege to [illegible]. The incorporators are Peter [illegible] Charles S. Ellis, John R. Young, [illegible] H. C. Horton, Jesse P. Williams, W. A. [illegible] and others.

Recent Sprague Roads.

Among the recent electric roads which have been installed by the Sprague Electric Railway & Motor company are two which are herewith illustrated. They are the Davenport Central railway of Davenport, Ia., and the Hartford & Wethersfield railroad of Connecticut. The Davenport Central railway, of which W. L. Allen is president, was installed about three months ago, and operates eight electric cars. The grades on this line are, some of them, extremely long and severe, and required four animals to each car when mule power was used on the line. Since the introduction of electric motors the road has been running successfully, and the gross receipts of the road during the months of September, October, November and December of 1888 average more than 60 per cent. increase over the gross receipts of the corresponding months of the year before. The directors and president of this line express themselves pleased with the operation of the road. During a heavy blizzard last month the road was operated by the electric cars successfully, and as this was one of the first experiences of an electric railway in a severe snow storm, the successful operation of the cars attracted much attention, and renewed confidence in the reliability of an electric railroad among the street railway men.

The electric railway illustrated as in operation in Hartford has been running about three or four months, and connects Hartford with Wethersfield, about three miles away. The overhead system in use is the regular Sprague, and it is considered successful by the citizens of Hartford.

One of the most complete electric power stations for railway work is that of the People's Electric railway at Scranton, Pa., of which an interior view is given in the accompanying engraving. This station supplies power for twenty cars, which are in operation in Scranton, using the Sprague overhead system of wiring. The dynamos, which are of the Edison type, are of 80 000 watts' capacity each, and wound for a maximum electrical pressure of 500 volts. The power station is brilliantly lighted by electric lights from a number of handsome electroliers in groups of incandescent lamps, in fives, each group being controlled by an independent switch at end of the engine room. Although it may seem incredible, it is stated that it costs less to supply electric power to the twenty electric cars which are in operation in the city, upon a line in which there are many steep grades, than it would to keep one horse. The explanation is that the power station of Scranton is very near to a pile of anthracite screens or culm, as it is

SPRAGUE ELECTRIC ROAD AT HARTFORD.

called, which may be had almost for the carting, and hence the item for fuel at this station is practically nothing. The Sprague road at Scranton has been in operation now for about two months, and it is said to be giving very great satisfaction. During the recent winter there were a number of severe storms, but the cars ran uninterruptedly, carrying large numbers of passengers, without hitch or break-down.

Welding by Electricity.

At the central station of the Malden Electric company of Malden, Mass., on Monday evening, the 4th instant, a successful exhibition of electric welding was given by the Thomson Electric Welding company of Boston and Lynn. The tests were made for the inspection of representatives of the press.

Some fourteen tests in all were made, and were all successful, the time for the operations ranging from a few seconds to one minute and forty seconds. Brass, copper and iron bars of small diameter, ¼th, 5-16th, 3-8th and 1-2 inch were first manipulated after being properly clamped. Then came the tests with larger bars; still later the joining of an extra heavy two-inch iron pipe, and finally round iron rods of two inches diameter were welded. Three transformers, each of which could be put instantaneously into connection with the dynamo, were used, the selection of any individual one by the operator depending upon the size of the metal to be welded. When one of the induction coils was in service the others were, of course, not in the circuit. After the welding of the smaller pieces of metal they were twisted until they broke, but the break in no instance occurred where the joint had been made, and what one operator had joined, others, even with the aid of mechanical devices, failed to pull apart. The tests were made by Russell Robb, under the direction of Hermann Lemp, the electrician of the company; John Tregoning, the superintendent of the factory at Lynn, was also present, as was Otis K. Stuart, who has charge of the specimen welding. No unions of dissimilar metals were made, but these can be effected easily, and the adaptability of the invention to both small and large work is particularly to be noticed. The invention is doubtless destined to be commercially successful. The company is far behind with its orders, though working its force until late every night.

The Edison Incandescent Lamp Patents in England.

A brief dispatch appeared in the WESTERN ELECTRICIAN recently, stating that the English Court of Appeal had reversed Justice Kay's decision, which had declared Edison's glow lamp patent invalid. The principal reasons for his decision Justice Kay gave as follows:

First, because the second claim is for a monopoly of incandescent lamps containing a filament of carbon for a burner, which claim, I think, is far too wide considering how little Edison had actually invented; secondly, because his specification does not describe a lamp which ever became, or, as I think, could have become, commercially successful; thirdly, because the directions therein contained are so insufficient that no one could have made the carbons he describes without considerable previous experiment; fourthly, because one of the processes described, namely, mixing the carbons with volatile powder, I believe to be practically injurious if done as Edison directs; fifthly, because the coating with a non-conducting, non-carbonizing substance, if not injurious, is of no practical utility; sixthly, because the same may be said of coiling the filaments, on which the patentee lays great stress.

The grounds on which the defendants Holland and others based their defense may be summarized as follows:

First, That Edison's invention was not novel, by reason of Mr. Swan having, prior to Edison's patent shown and described an incandescent lamp which was made of glass from which the air had been exhausted with platinum leading-in wires and contained a carbon pencil about 1-25th of an inch in diameter. Second, That Edison had not sufficiently described how his invention was to be carried into effect in two most important respects, viz., how such slender things as filaments were to be carbonized, and how a filament was to be made from a mixture of tar and lamp black. Third, That Edison had described a method of coating his carbon filament with some non-carbonizable non-conducting substance (which he called pyro-insulating), which would be fatal to the life of the filament.

The three judges of the Court of Appeal concurred in their decision sustaining the Edison patent. They went over the ground at great length, and reviewed a considerable portion of the voluminous testimony. Their opinions on the question whether Edison's invention was novel, are as follows:

Lord Justice Cotton said: The only alleged anticipation which I need consider is that of Swan's lamp, exhibited in December, 1878, and February and March, 1879, by Mr. Swan. In the previous case, on the evidence then before us, I thought the lamp would, on the construction put by the majority of the court on the specification, be an anticipation. How does the evidence now stand? It is now admitted that the carbon burner of Swan's lamp was formed into its shape before it was carbonized, and this removes one of the points much relied on by the plaintiffs in the former action. But we have now evidence, which was not before the court in the former action, of what was being done by Mr. Swan and by Mr. Stearn after the experimental trial of this lamp. We have the evidence of Mr. Swan and of Mr. Stearn. We have had before us the lamp, and we have the letters written by Stearn to Swan in 1879 and 1880, which were apparently admitted by counsel, to show what was being done by Swan and Stearn. We see that that lamp was treated by them as a failure, and that their attempt to correct its defects led to lamps which differed more widely than did the establishment from the lamp described in Edison's patent. This evidence assists the conclusion at which the court arrived in the former action, that Swan's lamp of 1879 was not a success, and I think enables me to come to the conclusion that this lamp was an exhibited lamp which failed and was abandoned, and that the difference introduced by Edison was one which changed failure into success.

Lord Justice Lindley said: The novelty depends on whether the Swan lamp first exhibited was an anticipation. The rod in that lamp had been carbonized after being put into shape, and if that lamp had been a success it would have been an anticipation. Swan had not got the key to success; his own efforts to improve this lamp show that he was not thinking of filamentous incandescent carbons, but of other matters. Still his lamp did emit light for a time, and was very near, though in my opinion not quite, an anticipation. I agree with Mr. Justice Kay in thinking that "the point at which Mr. Edison's instrument departed from Mr. Swan's was crucial, and the departure, though slight, has all the merits of a new invention, and produces a new result." The question of novelty I am considering is closely connected with, although really different from, the question of sufficiency of description given of Swan's lamp. Can it be said that Mr. Edison added anything to what was known, and sufficiently described the nature of what he added? In my opinion he did not in words distinguish his lamp from Swan's, but gave a description of a new type of body to be rendered incandescent, or, if I may use such an expression, a new type of wick. One mode of trying this is to ask if any one would make such a thing as Swan's lamp if he took Edison's specification. He would not. The two may be made to shave off into each other, but this does not prevent a man from perceiving the difference between the two types, and adopting the one which succeeds.

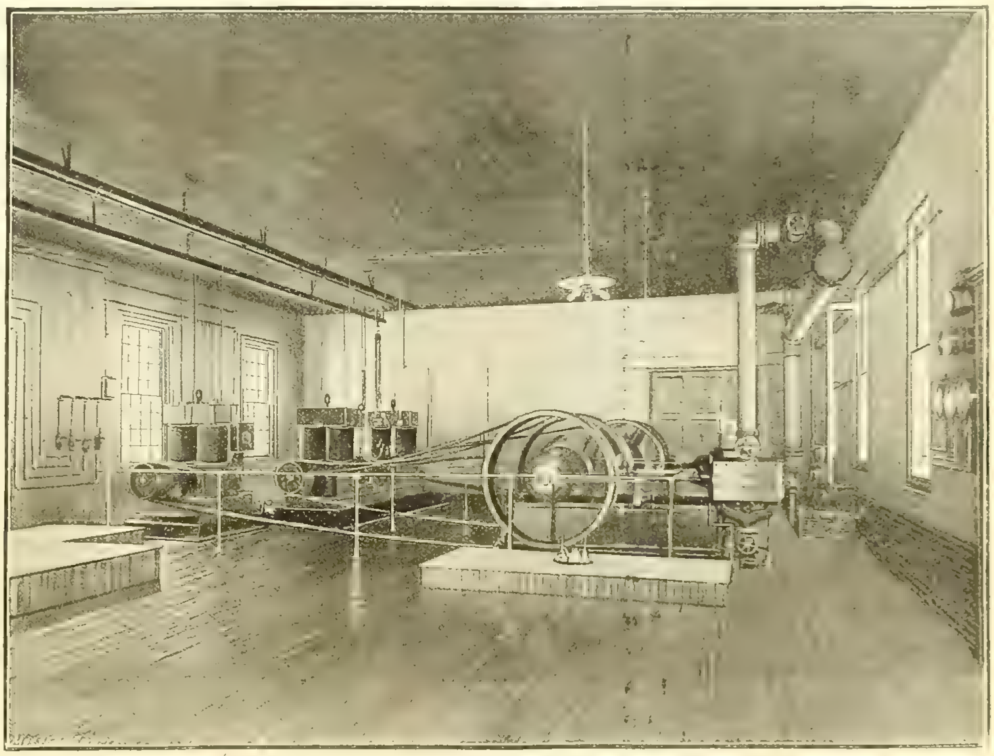
Lord Justice Bowen said: Was the Swan lamp an anticipation? We know now what the court did not know in the last action—that the carbon conductor in that was formed before it was carbonized. Was it a filament? The question is one of degree. I doubt whether it is a filament, and I still more doubt whether any one who saw it would understand it to be such. But in any case I think that lamp never was more than an experiment, on account of its failure and barrenness of all fruit, and that it was regarded even by its inventor as practically valueless in the race.

[illegible] ... the pyro-insulating ... [illegible] carbon filaments, the [illegible] ... though a certain amount of ... [illegible] might be necessary ... [illegible] carry out Edison's specification, it would only be such experiment as arose from want of skill and not from want of sufficient directions in the specification. With regard to the remaining point, the pyro-insulating, they were of opinion that the experiments made before Professor Stokes showed that if the material were dusted on to the tar putty in the manner in which they understood that Edison intended it should be used, then no evil results would follow.

The effect of the appeal is to leave the Edison company in possession of a valid patent controlling the manufacture of carbon filament incandescent lamps until the appeal to the House of Lords shall have been heard.

In commenting on the decision the London *Electrical Engineer* says:

The question in dispute is the validity of the Edison Swan combination patents. It is a fact admitted by everyone that Swan and Edison were simultaneously working out the question of practical incandescent lamps at about the same time. Swan had made lamps, but they were looked upon as imperfect, as was shown by letters passing between Swan and Stern. Edison about the same time obtained a patent for a lamp which the one side says is not practical, and has never been commercially made. The judges hold that the lamp of the patent is practical, and the validity of the patent has nothing to do with the lamp being made commercially. That improvements were to be expected directly the manufacture on a commercial scale commenced, was but natural. Such improvements were made, and the commercial lamps are the result of these improvements. Given the original more or less crude but practical idea, and hundreds of minds turned at once to its study, producing a crop of patented improvements, and which the patentees expect the law courts to proclaim valid patents. The law courts refuse to do anything of the kind and say in effect, "None of these recent improvements are inventions to be covered by a patent, and the patentees would never, without the aid of the master idea in the master patent, have invented anything of the kind. It is easy when you know the way." It is easy to improve somebody else's invention, but it is difficult to invent. That is, in reality, the crux. As will be inferred from our remarks above, the strongest objection against the validity of the Edison Swan patents is in the direction tending to show they are improvements of prior inventions, and not new inventions. The judges have not been convinced that this is so—hence their decision, which says though not in so many words, that Edison did really invent the practical filament.



SPRAGUE ELECTRIC ROAD AT SCRANTON.—POWER STATION.

The London *Electrical Review* is not pleased with the decision. It says in presenting a summary of the three opinions that "it may be interesting, though not instructive, to glance at the judgments separately." It makes this comment:

After we do not know how many weeks of solemn consideration, we certainly expected something less ponderously superficial than the three judgments delivered last Monday. The judges have never yet got rid of the idea that Edison's object was to make practical incandescent lamps, and not merely to make practical incandescent lamps for parallel lighting. They are also saturated with the notion that because incandescent lamps came into use after Edison's patent, they resulted from his patent. Moreover, they do not seem to think anyone but Edison was working at lamps in 1879. The crowning feature of all is the idea that by using a long thin carbon instead of a short thick one, a lamp was improved *per se*, that is, apart from the consideration of large or small leads. Of course, the whole matter lies in a nutshell. Edison's name is a sort of fetich, and the public, including the judges, have come to regard Edison as a sort of phenomenal inventor, and when he is advocated by such an awe-inspiring blunderbuss as the attorney general seems to be, cool reason has very little chance of success. As frequently urged in these columns, the trial of patent actions by the present courts is an absurdity, and must in some cases lead to injustice. The litigants have to some extent the remedy in their own hands as under the new act they have the power of demanding that assessors shall be called in. It may be interesting, though not instructive, to glance at the judgments separately.

New York Board of Electrical Control.

A special meeting of the Board of Electrical Control was called by Mayor Grant on the 5th, for considering the policy adopted by the United States Illuminating company. A series of formal charges were read by Commissioner Gibbens. It was stated that the company had obtained permission from the commissioner of public works to make fifty-seven openings for subsidiary connections with the subway cable, each opening being so made as to connect with a wire-carrying pole of the company, which is to be utilized as a light-carrying pole, and thus thwarting the intention of the board by preventing any reduction in the number of poles. Commissioner Gibbens said: "The consideration of this information leads me to declare that I believe the United States Illuminating company to be guilty of a gross breach of faith in accepting the opportunity to make a test of the electrical subways for the purpose of its business, or if not accepting the opportunity then much more so in taking advantage of it." Commissioner Gibbens recommended that the commissioner of public works be directed to revoke these permits that the forty-five days' grace be withdrawn, and that the public works department be directed to take down at once all the poles and wires of the United States company in streets where subways have been provided.

The mayor asked Mr. Lynch, who represented the company, what he had to say. Mr. Lynch replied: "I have but little to say against the carefully worded charges."

The mayor suggested that he had better say something. Mr. Lynch said: "We have tried to do the best we could, and we have tried to keep faith with the board."

Commissioner Gibbens said: "It appears to me that you have willfully deceived the board."

"Mr. Lynch: "It's false, sir; it's false."

The mayor pounded the table for order, and declared that he quite agreed with the commissioner. He added: "I have all along tried to act fairly by these companies, and especially with the United States company, but it seems to me that it has been trifling with us. Now, I want it distinctly understood that the wires of this company as well as every other company must go underground. I now authorize the commissioner of public works to revoke the permit recently granted to this company, which gave it permission to lay a mile test cable."

The commissioner of public works, who was present, notified Mr. Lynch that the orders of the mayor would be immediately carried out.

Mr. Lynch said he was being persecuted by the board.

The mayor replied, "That is not true. You are not being persecuted by anyone. The law says that the wires [illegible] as fast as they are built, and we are here to obey the law, and without any personal spite to gratify, [illegible] lights, I want you to take down [illegible] your wires underground without any [illegible].

Mr. Lynch [illegible] "We are being driven out of the business [illegible] lamps on Broadway, and [illegible] one. It is an outrage to injure us this [illegible].

[illegible] "You have some lights [illegible] attempt to connect [illegible] system. You have sought to [illegible] you to keep your wires [illegible].

[illegible] We have no other [illegible]

[illegible] torn up the street, [illegible] lamp.

[illegible] I would like to [illegible]

[illegible] my own con[illegible]

[illegible]

[illegible] for order [illegible]

to be laying a trap for the commissioners, and that when the time came for the authorities to remove the poles, they would find the police wires strung on the Western Union poles. President French of the police board was summoned, and when it transpired that there was no appropriation for the purpose of burying the police telegraph wires, Corporation Counsel Beekman was consulted, and arrangements were made for an appropriation.

Mr. Lynch withdrew in company with Commissioner Smith to make the necessary application for permits to make a test of ten arc lights in Broadway, supplied from cables laid in the conduits, the wires to be placed on disused gas lamp posts. This permission was granted at the meeting of the 7th, when the board held a very short session.

Certain Phenomena Connected with Imperfect Earth in Telegraph Circuits.[1]

BY A. E. KENNELLY.

PART I.

Since the earliest days of commercial telegraphy—the days that first reaped the labors of Sœmmering and Steinhill, Gauss and Weber, Cooke and Wheatstone—the substance of our planet has been impressed into such universal conducting duty, that now scarcely a circuit closes, be it across an ocean or be it across a meadow, but embraces its share of the earth in its completion; and the task thus imposed is generally borne so readily and executed so perfectly that, until the existence of the eavesdropping telephone, it was really doubted whether in truth the earth could or did conduct the current entrusted to its care.

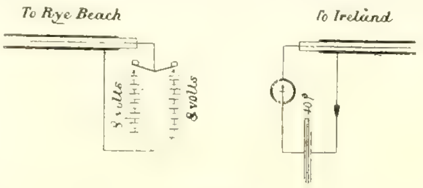


FIG. 1.

Considering, then, the great obligations telegraphy owes to the earth—that the existence of some hundred thousand miles of metallic conductor, at present in daily telegraphic operation, implies in a certain sense the corresponding twin existence of an equal length of terrestrial conductor ready made by Nature; that it has even been possible to telegraph over a space of which the metallic conductor formed but a very proper fraction—the cases that are met with where the earth fails to fulfill its part excite astonishment more by their rarity than by the force of those laws whose mandates they obey.

Almost all such cases of imperfect earth are, we know, traceable to some fault either in the earth connection itself or in its immediate neighborhood; and a remedy is found by adequately increasing the surface area of the buried electrode, or the conductivity of the ground in its vicinity; so that they are not really failures of the earth's conduction, but failures in securing the necessary degree of connection with the earth's mass.

There are, however, other cases, brought about by conditions more deeply seated and more rarely met with, which will occupy our present attention.

A paper by James Graves, "On Vibrations due to Earth Plates," was read before this institution in January, 1875,

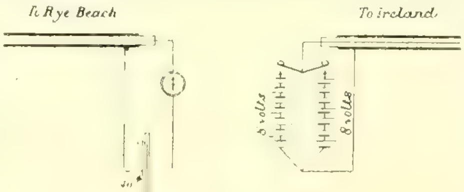


FIG. 2.

and it will be seen that the phenomena therein described are probably related to those that will be presently detailed. Although the matter has not occupied the institution's direct attention since that date, no doubt some of its members will have independently observed similar phenomena, and can bring forward such additional evidence as cannot fail to elucidate a subject at once replete with technical interest and important practical bearings.

These phenomena are presented by the Atlantic cables of the Direct United States Cable company, with whose permission the facts are laid before the institution.

The two cables of this company terminating in Nova Scotia run to Ireland and to Rye Beach respectively. Their landing place was originally Torbay, N. S., but they were removed thence to Halifax some eighteen months since.

Some vibration of the mirror spot, due to electrical disturbance, was noticed on first joining up the circuit at the office through instrument and condensers, but this was at the time attributed to faults which then existed in the cable. Beyond this continual vibration, no noteworthy feature occurred until six days later, October 29th, when the Rye Beach cable was landed at the same cable house, and joined up with the office by a piece of similar pair of cables running through iron piping in the same trench with the other above mentioned. This cable is worked on the double current Morse system without condensers, and it was immediately [illegible] that [illegible] to Rye Beach with 12 volts of battery power [illegible] disturbed the mirror spot on the Irish [illegible] although each cable made earth separately [illegible] the insulated return cables [illegible] Rye Beach and not disturb the [illegible] the operation of the Irish cable [illegible] apparatus of the Morse circuit.

[1] [illegible]

The only remedy that could be, or has since been, practically available, without adding to the retardation of the circuits, was the reduction of the Morse battery power on one hand, and the sensitiveness of the Irish mirror on the other, as far as the operation of the circuits would conveniently permit.

After the removal of the faults in the Irish cable, the vibrations of the mirror still continued, and it was noticed that not only these, but periods of disturbance coincident

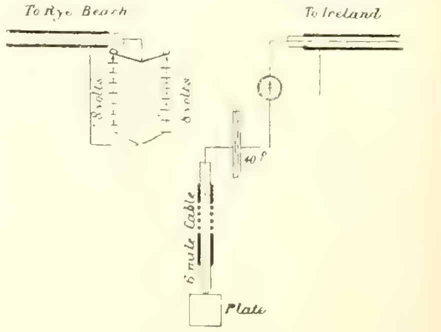


FIG. 3.

with local meteorological changes, affected the signals more than had been on record with the same circuit when worked previously from Torbay. On this was superposed the interference caused by transmission on the Rye Beach circuit, and the combined disturbance at times made the mirror signals difficult to read.

The Rye Beach shore end was at first laid very near to the Irish cable, and actually over it at one or two points. The cables were, however, subsequently separated, although they still necessarily lie at different points in close proximity. This separation of the cables was found to have sensibly lessened their interference.

The operation of the cables from the cable-house, instead of from the office, was found to produce no change in the nature or degree of disturbance while experiment failed to produce any visible interference between the trenched cable

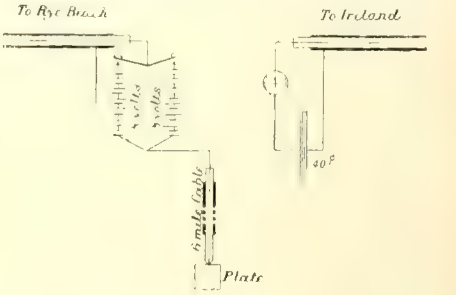


FIG. 4.

circuits from office to beach, even on the most delicate instruments.

A third cable was then laid from the cable house across the harbor. It had a total length of 5.8 knots, sheathed up to within half a mile of the sea end. This unsheathed half mile of core terminated in a copper earthplate one yard square, nearly on a line between Trumcap Rock and Hartland Point. This well insulated line offered every prospect of securing a good and independent earth by its large terminal plate. When, however, it was joined up at the cable-house with the Irish circuit in the place of the Irish shore end sheathing, the interference from the Rye Beach transmission remained as marked as ever.

To determine the nature of this obstinate interference, a series of experiments was made at the cable-house as follows: All existing connections were for the time dismantled, and only the two cables, the two earth wires soldered to their respective sheathings, and the core of the third cable, or six-mile earth, were brought up to the testing table.

The resistances between these three earth-wire terminals was measured as follows by bridge:

Between Irish sheathing and Rye Beach sheathing	.16 ω	All steady.
Between Irish sheathing and six mile earth	65.7 ω	
Between Rye Beach and six mile earth	65.7 ω	

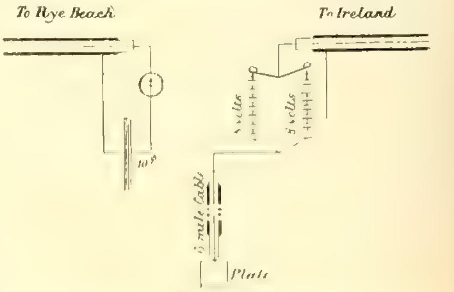


FIG. 5.

From which the resistance of each sheathing earth connection would, of course, be .8 ω, and of the six mile earth 65.6 ω.

The only apparatus then retained for investigation was a Daniell battery of 14 gravity cells—used with, and sometimes also without, a pole changer—for exciting disturbance, and a sensitive speaking mirror—used with, and also with-

out, condensers of 40 ⋅⋅ capacity—to render any interference visible.

Experiment 1 (see Fig. 1).—Sending reversals from seven cells into the Rye Beach cable produced vibrations of the spot on the mirror instrument in circuit with the Irish cable, its sheathing, and 40 ⋅⋅

Experiment 2.—Similarly, sending reversals into the Irish cable, using its sheathing, produced vibrations on the mirror in circuit with the Rye Beach-cable condenser and sheathing.

Experiment 3 (see Fig. 2).—Sending reversals into the Rye Beach cable produced vibrations on the mirror in circuit with the Irish cable condenser and six-mile earth.

Experiment 4 (see Fig. 3).—Sending reversals into the Rye Beach cable, using the six-mile earth, produced vibrations on the mirror in circuit with the Irish cable condenser and its own sheathing.

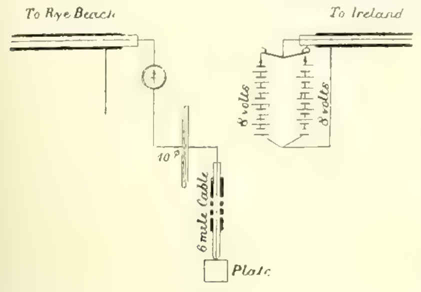


FIG. 6

Experiment 5.—Sending reversals into the Irish cable, using the six-mile earth, produced vibrations on the mirror in circuit with the Rye Beach cable condenser and its own sheathing.

Experiment 6.—Sending reversals into the Irish cable, using its own sheathing, produced vibrations on the mirror in circuit with the Rye Beach cable condenser and six mile earth.

Experiment 7.—Sending reversals on the circuit formed by the six-mile earth, battery, and Rye Beach sheathing, the disturbance on the mirror in circuit with the Irish cable condenser and sheathing was more decided than in any of the preceding experiments.

Experiment 8.—Similarly, sending reversals on the circuit formed by the six mile earth, battery, and Irish cable sheathing, the disturbance on the mirror in circuit with the Rye Beach cable condenser and sheathing was equally great.

Experiment 9.—The two last experiments were repeated with the condenser removed and the mirror in direct circuit between cable and sheathing. The continual vibration of the spot made observations difficult; but during periods of comparative quiescence it was soon determined that the disturbance produced by depressing one of the keys was not of a momentary nature only, but consisted of a small deflection, permanent during the whole period of key application, and of direction depending upon the key selected. It was also ascertained that this deflection was not due to any local electro-magnetic action.

Experiment 10 (see Fig. 4).—On sending reversals between the two cable sheathings in circuit with the battery, no disturbance could be detected on the mirror in circuit with one of the cables and the six-mile earth.

This small steady deflection produced by holding down the key in either of the two cases tried in Experiment 9 was more plainly visible when the mirror was in circuit with the Rye Beach cable, which, besides its shorter length,

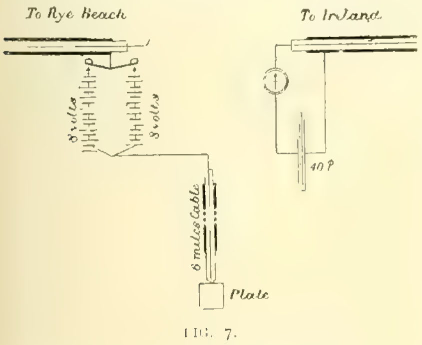


FIG. 7.

had no condenser in circuit at the distant station. To obtain some quantitative information regarding the strength of current represented, the 14 cells were connected in series and more careful observations made.

Experiment 11.—Closing the circuit formed by the 14 cells, the six-mile earth and Irish sheathing, measurements were made of the steady deflection so produced on the mirror joined up with the Rye Beach cable and sheathing.

The deflection obtained was subsequently found to approximately represent the two-hundred-thousandth part of an ampere—*i. e.*, 5 micro-amperes—and its direction was observed to be that indicating a current entering the Rye Beach cable from that pole of the battery which was connected to the Irish sheathing, reversing when the battery was reversed. Thus, in the figure the copper pole of the battery being shown connected to the sheathing, the deflection represented a current from the copper pole entering the Rye Beach cable through the mirror.

Experiment 12 (see Fig. 11).—The Irish sheathing was replaced in the battery circuit by the waterpipe earth connection at the office through the trenched cable. On depressing the key the mirror showed the same permanent degree of disturbance as before in each cable circuit.

Experiment 13.—This experiment was a repetition of No. 3 with the condenser removed. It was [illegible] observed in this case that the disturbance [illegible] permanent during the depression of the battery [illegible] of a small [illegible] of the spot at the opening and [illegible]ing of the battery circuit.

Experiment 1[illegible] (see Fig. [illegible]).—This was carried out at the office, situated in the principal street of the town and nearly opposite the Western Union Telegraph office, fifty yards distant. As the Western Union wires are overhead, and the earth connections made for them are the gas and water mains, which, with the telephone lines, form the only metallic connection between the two buildings. With the courteous assistance of the Western Union officials, it

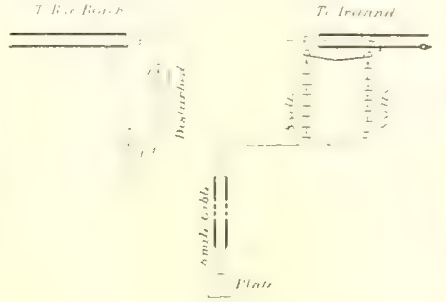


FIG. 8.

was arranged that at a given word by telephone several of their circuits should suddenly be operated and, again, all stopped.

When this was done the effect was distinctly visible upon a mirror in circuit with each cable, the disturbance being greater on the Rye Beach line, the earth connections being the cable sheathings through the insulated cables in the trench. Only four known causes could under any conditions produce interference between the two cable circuits these being, of course, electrostatic induction, electro-magnetic induction, leakage, or bad earth connection in common, and in the absence of evidence any one or more might produce it, although no reason could be demanded for the operation of any, since cables lie in other parts of the world for greater distances at equal proximity without the least visible interference.

Experiment No. 10, together with the preliminary trials with the trenched cables, showed that the causes were not

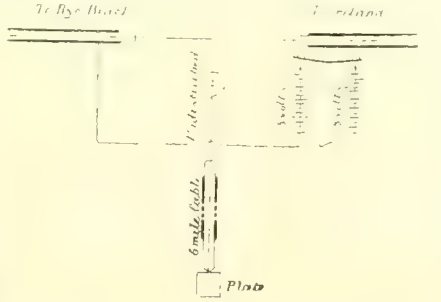


FIG. 9.

to be traced locally to these or to the apparatus, and the high insulation of the cables and circuits, together with the fact that the tests were carried out at the cable house, precluded all possibility of leakage being concerned, so that the operating causes were thus limited to the two forms of induction and bad earth

The first six experiments did not directly point in favor of any particular cause, but Nos. 7 and 8 rendered the possibility of electro-magnetic disturbance untenable, since the exciting circuit, except in the cable sheathing itself, took a course almost at right angles to the two main cables. They further showed that the interference was such as a deficient earth connection would produce. Experiment No. 9 confirmed this view, since no form of induction could set up the steady deflections observed; and leakage being out of the question, bad earth was the only cause that could produce them. It was further necessary to suppose that not only one but both cable sheathings failed to secure good earth, and that the resistance in their respective earth connections was common to both.

Experiment 11 corroborated this position; and No. 12 did more, for it extended the limits of this bad earth region over the whole water pipe area of Halifax, as it would have

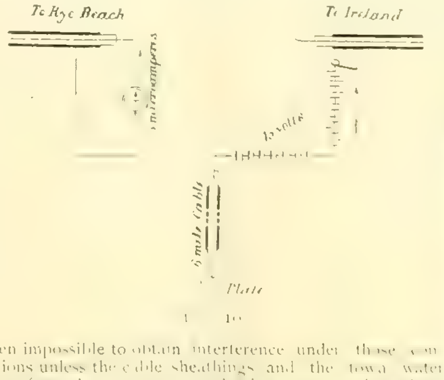


FIG. 10.

been impossible to obtain interference under those conditions unless the cable sheathings and the town water pipes formed a common conducting system throughout whose limits imperfect earth connection existed. Finally,

[illegible]

The Book Table.

[illegible] hundred [illegible] The [illegible] appear in permanent form. The volume will pro[illegible] the institute, but to a large number of [illegible] who have followed with interest the subjects discussed [illegible] some book; the type is large, the letter-press admirable, the paper of excellent quality, and the binding substantial. The indexing has been carefully done, so that the book is convenient

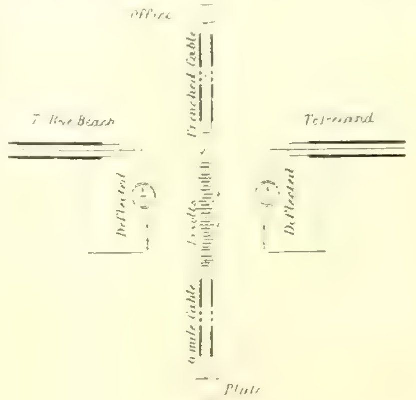


FIG. 11.

as well as valuable as a work of reference. Included in the volume are the secretary's monthly indexes to periodical electrical literature, which have already proved of great assistance to those who are investigating in certain departments. The volume will be a valued addition to many electrical libraries.

ELECTRICAL TRADES DIRECTORY AND HAND BOOK. Published by the Electrician Printing & Publishing Company, London; 600 pages royal octavo; price, 4s. 6d.

This book will be found to contain a large amount of interesting matter. In addition to a

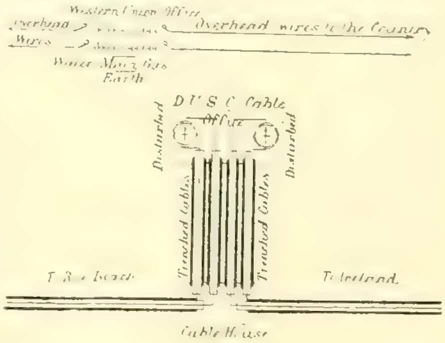


FIG. 12

carefully compiled alphabetical list of persons engaged in electrical trades in Great Britain and colonies, America and the continent, it contains a number of valuable tables, patent law notes, obituary notes, and details of the work accomplished last year. It contains a vast amount of matter so arranged that it can be easily referred to. Included in the work are a hundred or more pages devoted to biographical sketches of prominent scientists identified with the development of electrical interests. A large number of cuts illustrate this portion of the book. A handsome steel engraving of Sir W[illegible] is contained in the book.

The San Diego trustees have granted to the [illegible] Electric Light company a franchise for an electric light plant. Two [illegible] Brush machines will be installed at once.

Western Electrician.

EVERY SATURDAY.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome, and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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IN the New York letter the advantages of electric lights on warships are summarized.

IT is stated that the project to erect a statue of [illegible] has been received in England with enthusiasm, and that a large sum will be raised for the purpose.

A BILL has been introduced in the Michigan House of Representatives amending the present [illegible] gas companies by empowering them exclusively to supply their [illegible] light and power by electrical currents. The committee on private [illegible] to which the bill was referred, is [illegible] corporations [illegible] unconstitutional.

[illegible], of the Milwaukee fire department [illegible] on with the fire and [illegible] alarm telegraph be extended so as to in- [illegible]

[illegible]

tember we have established in the city of Chicago 13,000 electric lights. Since December 1st the city has established over 200 arc lights.' Altogether, electricity has superseded gas jets in Chicago."

THE alleged electric sugar swindlers are safely housed in jail in New York. They claim that they possess the secret of refining sugar by electricity, and that the process is perfectly feasible. They assert their willingness to die rather than reveal the marvelous secret.

IT is said that there is little prospect that the Eckhardt-Baker telephone bill will pass the Illinois legislature. In all probability the rates will remain as they are. In the Missouri legislature the votes on amendments to the Dempsey bill would seem to indicate that the measure will be passed when it comes to a vote. As the companies in Missouri insist that they cannot continue their business if the bill is enacted, it is to be hoped that the legislators will proceed a little more cautiously than they have been doing for the last few weeks.

ELECTRIC lighting has scored a triumph in England. In the future Queen Victoria's private apartments are to be illuminated by incandescent lamps. Her majesty has always been extremely conservative. She has been averse to any light in her own apartments except that of candles, and she will not tolerate coal, but uses logs of wood, the supply of which is both systematic and extensive. An installation of incandescent lights was made about a year ago at Windsor, but only the private terraces and some of the offices were lighted by electricity.

JOHN ERICSSON, the engineer whose inventions have given him a world-wide reputation, died at his home in New York city March 8th. He designed many improvements in steam engines and locomotives, and his inventions for increasing the efficiency of warships revolutionized the navies of the world. The Monitor, which he designed and constructed, will always make his name a familiar one in the history of the rebellion. He was at work until a few days before his death on his sun motor. The invention was not completed, but it is said that full directions have been left with his engineers for the completion, with a sufficient sum of money to carry out his plans, under the direction of the executors.

THE greatest interest seems to be manifested in fuel oil throughout the country. Paragraphs have been noticed in a great many papers stating that tests were about to be made. An exchange says: "It is well to remember, also, that many attempts hitherto of substituting liquid fuel for coal or coke have not turned out successfully in a financial sense, because of the crudity, inadaptibility and hap-hazard construction of the medium through which the oil was transformed into heat. It was known all along that the knowledge of the economical use of oil was but in its infancy, and while a great number of inventions in the way of burners were soon offered to the trade, none fully answered the purpose of converting oil into heat in such a method and at such cost as would warrant any manufacturer to perceive at a glance the advantage in every respect of substituting oil for any other fuel. The burners of the future must be simple in construction, durable, easily operated, and free from leakage, dripping and waste, and its inventor may be sure of a fortune."

DEFECTS in the bill which provided for executions by electricity in New York state have been pointed out in this column. The law declared, [illegible] that criminals must be executed by [illegible] of state prisons, but no [illegible] applying the electric current was [illegible] was left to adopt such [illegible] thought best. In the bill as originally drafted, it was provided that the su[illegible] bound, before Jan. 1st, 1889, "cause an electric apparatus suitable and [illegible] of the act to be con[illegible] of the state prisons, [illegible]ary appliances for the execution of convicted criminals." In some inexplicable manner this provision was left out when the bill was passed. The defect, however, no longer exists, for chapter 36 of the laws of 1889, which the governor has just signed, appropriates $10,000 "for the procurement of proper electrical apparatus and machinery by the superintendent of state prisons for the execution of criminals." Although the law applies only to those who commit murders after Jan. 1, 1889, there are several such now awaiting trial.

THE copper trust again occupies the attention of the financial world. Last week the collapse of the French syndicate was anticipated, but, as usual, it weathered the storm, and appears even more powerful than ever. It was announced that the cry of alarm was raised by shrewd speculators, but it is unnecessary to consider this highly improbable statement. The fact seems to be that the trouble arose through a disagreement within the syndicate. Since the copper trust was organized prices have advanced, and as a result consumers have been reducing their orders as much as possible. War was declared on the trust, and the syndicate soon found itself compelled to demand a reduction from the prices originally agreed upon with the owners of mines. A so-called metal bank was formed, and the shares of this institution rose to enormous figures. Speculation followed, and copper stocks led the market. Copper accumulated, however; shares in the bank and trust declined; the syndicate appeared doomed; and when M. Deufert Rochereau, president of the Comptoire d'Escompte, which had backed the trust, committed suicide the crisis was reached. Yet the trust did not collapse. A conference was called in New York. The companies agreed to restrain the output, and now it is claimed all is well. It is also said a reduction of 2 cents per pound was agreed upon by the owners of mines. At any rate, the French syndicate is still master of the situation, and the opponents of the copper trust have again failed to break the combination.

THE utilization of the electric motor for operating draw-bridges is attracting the attention of municipal corporations as well as bridge constructors. In a recent issue of the WESTERN ELECTRICIAN attention was called to the successful operation of a draw-bridge over the Pequannock River at Bridgeport, Conn., by a $1\frac{1}{2}$-horse power electric motor. This bridge weighed 300 tons, and before the introduction of the motor, had been a source of annoyance to the community. Speaking of the use of motors for these purposes, the Chicago *Herald* says, editorially: "It would be an excellent idea, if the city electrician should include electricity in his calculations with reference to the turning of bridges hereafter to be built. With steam, the weight of the structure is very largely increased by the boilers and water, as well as other cumbersome appliances. There must now be a steam engine and boiler for each bridge. In case electricity were used it could be generated at some central point and carried by wires to the various bridges. The bridges could, with only the additional weight of an electric motor, be made much lighter than they are at present. This would be a substantial economy in the cost of construction, which would lighten materially the expense of bridge building. In truth, the time is not far distant when the electric motor will be an economical substitute for the great majority of engines now operated by steam. The latter are stiff, unyielding, generating unendurable heat in summer, and must have all their parts near where the work is done. Each building using power must have its boiler and engine in the basement, and it is often the case that steam pipes have to be led to other floors of the building for the conveyance of power, or else the work has to be transferred by belts, causing material loss by expensive friction. It cannot be long before electricity will supplant steam power, as it now is doing with gas. The difference between gaslights and the electric lamp is no greater than is the width between steam and electric motors. The latter are in every respect better, and, what is more convincing than all else, they are much cheaper."

Some Peculiarities of Electro-Deposition.[1]

PART II.

BY ALEXANDER WATT.

Crescent-shaped deposits.—Results of this character, as in the foregoing case, usually occur with solutions poor in metal, when worked with a feeble current. I have also obtained similar results when endeavoring to reduce aluminium from solutions of its salts, both with weak and very strong currents; but in these cases it was not aluminium, but traces of iron and other foreign metals with which the aluminium salts were impregnated, that became reduced by the current. When treating aluminium salts, but more especially acid salts, with currents of varying density, I have very frequently found a deposit to take place only at the upper surface of the cathode—not as shown in Fig. 6, but of a crescent form, as illustrated in Fig. 7. These deposits, however, were, as I have stated, due to metallic impurities contained in the aluminium salts used, and were in no degree due to the aluminium itself. In some instances the same form of deposit will take place whether the cathode is allowed to remain stationary or is briskly agitated in the bath, but more generally under the latter condition.

Deposit only on lower part of cathode.—When electrolyzing a weak solution of persulphate of iron (prepared by adding three fluid drams of the concentrated solution to about 10 ounces of water) with the current from three Daniells, I found that the deposit, which commenced at the bottom and lower edges of the cathode, slowly proceeded upward for a short time, after which no further deposit could be obtained upon the upper surface of the negative plate. An example of this is shown in Fig. 8. I may state that many results of a similar character and form have been obtained from other iron salts, and

FIG. 5. FIG. 6. FIG. 7.

also from solutions of other metals. In the illustration it will be noticed that the upper portion of the film forms an arch-like curve.

Upper portion of deposit an inverted arch.—In the foregoing example we have noticed that the upper part of the deposit was curved like an arch; in the illustration, Fig. 9, the curve is in precisely the opposite direction, forming, as it were, an inverted arch. This result was obtained during the electrolysis of a very weak solution, composed of persulphate of iron and sulphate of soda, with the current from three small Daniells. In this case the deposit started at the bottom of the cathode, gradually spreading upward, when the film assumed the form indicated in the wood-cut, no deposit whatever taking place beyond the outline shown.

Deposit only on back of the cathode.—When electrolyzing a solution of potassio-tartrate of cobalt with the current from two Daniell cells, a very slight trace only of metal appeared on the surface of the cathode—a brass plate—facing the positive electrode. On examining the back of the plate, however, I was surprised to find that it was coated all over with cobalt. Thinking that possibly I had inadvertently turned the plate when first examining it, I repeated the experiment with a newly prepared plate, when I found that a precisely similar result was obtained, namely, that the metal deposited uniformly on the surface of the cathode farthest from the anode—that is, the back of the plate—while the front of the plate had scarcely a trace of metal upon it. The same experiment was repeated two days after with exactly the same result.

Partial metallic deposit on lower part of plate only.—A solution of sulphocyanide of cobalt was electrolyzed with the current from three Daniells, and a deposit of cobalt slowly formed on the lower edges of the plate to the extent of about half an inch, when a dark brown non-metallic film was deposited in continuation of the metallic film, thus having a graduated tint of color, the darkest portion being nearest the upper part of the plate.

Zigzag deposits of copper.—A solution of borate of copper in acetic acid was heated and electrolyzed with the current from a single Daniell. A steel plate was used as a cathode, and this was kept briskly in motion in the bath for about a minute. When withdrawn from the solution it was found that the deposited metal assumed a very peculiar zigzag form, as represented in Fig. 10, while the deposit on the back of the plate, the form of which is shown in Fig. 11, presented a very similar character. The deposited copper was dull, with the exception of a narrow band beyond the margin of the film, which was exceedingly bright. This latter fringe of the deposit is shown by the white out-

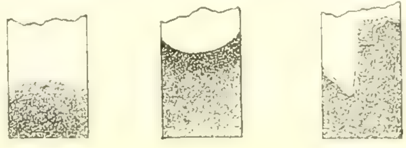


FIG. 8. FIG. 9. FIG. 10.

lines beyond the darker shading of the illustrations. The dotted lines above the white outlines referred to show where a slight film of copper appeared at the spots indicated.

Deposit of a horseshoe form.—This peculiar result was obtained under the following conditions: A portion of the foregoing solution was again diluted with water with a view to ascertain whether any further freaks of deposition would present themselves. A clean steel plate was then immersed in the bath, the same current being used, and kept gently in motion. On removing the plate the deposit was now found to have assumed the form shown in the accompanying illustration (Fig. 12), from which it will be seen that the deposit, which was thicker at those parts indicated by the darker shading of the wood-cut, assumed a form somewhat resembling a horseshoe, while the remaining portions of the plate were entirely free from any deposit whatever. It was next determined to see if a stronger current would make any, and what, difference in the form of the deposit, for which purpose two Daniells in series were used, when the succeeding deposit was observed to take place in detached patches, as indicated in Fig. 13, the same character of film being discovered on both sides of the plate. It should be mentioned that the latter result was obtained when the cathode was allowed to remain stationary in the bath for about a minute. As in the preceding results, the patches of deposited metal were fringed with a perfectly bright band of copper, the remainder of the deposit being comparatively dull.

1 Abstract of paper in the London *Electrical Engineer.*

Something Electricity is Doing.[1]

BY CHARLES BARNARD.

PART II.

When the present system of manufactures began in the early part of this century the great mills and factories clustered around the water powers. Holyoke, Lawrence and Manchester grew up beside their turbines, and it was the water-fall that settled the value of real estate in our manufacturing towns. With the improvements in the steam engine and the locomotive there came a change to the commercially more convenient cities. The manufactures left the small towns by the rivers and gathered in the cities, and to-day we find Philadelphia and New York are the great manufacturing centers. The factory must stand near its turbine or engine, whether that is the cheapest, the safest and best place or not. It is safe to say that the electric motor will produce as great a change as ever was seen before, because it is now possible to erect the motive power plant in one place and the manufacturing plant in an entirely separate one. Many interesting industrial and even social questions at once arise. The position of the engine may be low or wet, near a canal or a noisy railroad yard, in an unhealthy or a morally "infected district," alike injurious to the goods manufactured and to the workpeople who make them. Cheaper, drier, safer and pleasanter sites may be only a few hundred feet away, and yet by our present system the factory hands, men, women and little children, must huddle together in a physical or moral swamp in order to be near the motive power on which their work and wages depend. It is the same with the turbine. It must stand at the foot of its waterfall, and the factory must be built on massive and costly foundations [illegible]

1 Century for March.

[illegible] t of the conversion of energy. The [illegible] 9 per cent. between the prime mover and the dynamo; that is, the dynamo receiving 100 horse power from its prime mover delivers to the conductor [illegible] horse power [illegible] a mile long [illegible] to the motor only [illegible] the motor one mile from the engine, entails a further loss so that finally only 71 horse power [illegible] to the machinery. The great commercial and industrial problem before us is to settle how far this loss of power in conversion may be offset by cheaper buildings, cheaper land and lower rents. There is every reason to think that in many places, notably in Boston and New York, the question has been settled in favor of the motor. It must also be observed that with our present system of mechanical conversion by belts and shafts there is a loss in transmission, and the question is, Which is cheaper, the single loss by mechanical transmission, or the three losses by the motor? There can be no doubt that for all distances beyond a very few hundred feet the motor is the cheaper. This, at least, seems to be settled: the motor is cheapest the moment the factors of construction, land values, sanitary safety, and security from flood and fire are taken as real parts of the problem. The cable road indeed conveys power for a mile or more by means of its traveling belt, yet it is enormously wasteful. The larger part of the power must be consumed in moving the cable, and every turn at street corners involves a loss of power. With a wire there is, so far as can be detected, no loss whatever by bending the wire at a right angle. To all this we must add, in favor of the motor

FIG. 11. FIG. 12. FIG. 13.

complete escape from the heat, noise, dust and ashes, and danger from fire that must always accompany the steam power plant. By far the larger part of the fire losses in manufactures of all kinds springs from fires started by the boilers. With the motor the factory may be removed to a safe distance beyond all danger. The boiler house may burn, but the mill need no longer go with it.

To the student of social science the electric motor is full of suggestions for the future. If power can be subdivided and conveyed to a distance, why may not our present factory system of labor be ultimately completely changed? People are huddled together under one roof because belts and shafts are so pitiably short. If power may traverse a wire, why not take the power to the people's homes, or to smaller and more healthful shops in pleasanter places? To-day we find sewing women crowded into a hot, stuffy room, close to the noise, smell, dust and terrible heat of some little steam engine at one end of the room. The place must be on a low floor because of the weight of the engine, and the cost of carrying coal up-stairs. Let us see how the work may be done with motors. We may take the elevator in a wholesale clothing warehouse on Bleecker street, and pass through the salesrooms to the top floor. The building is lofty and of light construction, and yet we find in the bright and pleasant attic above the housetops a hundred girls, each using power. They are seated at long tables, each one having a sewing machine, and secured to the under side of the table is a small electric motor, one to each machine. The operator has only to touch a foot pedal and the motor starts, giving about one-tenth of a horse power, at very high speed. If the speed is too fast it can be regulated at will by the pressure of the foot on the treadle. There is no heat, no dust or smell, and only a slight humming sound, the sewing machine itself making more noise than the motor. The room is sweet, clean and light, and it is in every respect a delightful work room. If we look out of the window we see two insulated wires passing under the sash down to the electric light wires on the poles below. There are people who cry out against the overhead wires and would pull them all down. Some say they would be buried underground. Meanwhile, is it not an immense gain to these working girls to be placed in a sweet, safe room far from the maddening engine? In another street on Broadway we may see a different arrangement. A two horse power motor takes its current from an electric light wire in the street, and transmits it by shafting placed under the work tables. Each operator with a touch of the foot throws her machine into gear and takes her share of the two-horse power.

In these manner it is possible to go to many places in our cities and find motors of all sizes [illegible] converting the energy flowing in the street wires into power

for driving printing presses, circular saws, elevators, [illegible] of every kind. It is not so much a question as to what the motor will do as of the convenience of reaching an electric light wire in the [illegible] there is not a single [illegible] manufacturing plants where "power to let" is to be painted on the door that is not considering the question between engines and motors. [illegible] large building now going up in New York, and intended to be let out with power in small shops on every [illegible] has no provision whatever for shafts or belts. The engine and dynamos will be placed in the basement and wires laid in the walls to small motors placed on every floor. Moreover, there being an excess of steam power, the wires will also be laid to other buildings within a radius of half a mile in every direction. The saving in construction and insurance, and the gain in cleanliness, quiet, safety, and healthfulness in that neighborhood, will be difficult to measure in dollars and cents.

In mountainous districts, where it is difficult to transport steam engines, and where water power is often cheap and abundant, the motor appears to open a remarkable future to our mining interests. The introduction of motors at Big Bend, on the Feather river, Butte county, Cal., may hint at this future by showing what has already been done. At this place turbines drive dynamos, supplying a current that travels through a circuit of eighteen miles, and at fourteen points alone the line motors are used to drive pumps and hoisting machinery, and by branch wires the power can be used a mile on either side of the main circuit. This is only one instance of what is being done, and [illegible] for the transmission of energy in our mining districts.

[illegible] of the most curious things in the behavior of electricity [illegible] that a current will flow from one conductor to another if they merely touch each other, and even if the point of contact is continually changing. Thus we may have a "rolling contact," as when a wheel rolls along a wire. This simple fact is the foundation of the entire system of electric railroads. The first experimental use of [illegible] that it is possible to convey energy through a wire to a motor traveling on a track, and so conclusive were these first experiments that throughout [illegible] at once [illegible] to the subject of electric railroads. Several of the earlier plants are still in [illegible] of mechanical construction [illegible] country. [illegible] the electric railroad [illegible] A year ago [illegible] electric road [illegible] [illegible] formed, and [illegible]

the car by means of a wire placed under the track or hung over the car on poles remains to be seen. At present the larger part of the electric roads [illegible] wire in some position near the track.

Within the past ten years there has been a remarkable increase in the number of electric lighting stations, until they are now to be found in every town of any considerable size in the country. [illegible] electric light circuit may be also a source of power. Motors adapted to both the arc light and the incandescent light systems can be connected with one or other of these light circuits and draw power instead of light from its wires. Centers of distribution for power are therefore already widely established, and it is now perfectly easy and convenient to obtain power along the line of these light circuits.

Regarded as a machine, the electric motor is remarkably efficient, considering the very few years, hardly months, in which it has been manufactured on a commercial scale. Of the half dozen principal companies manufacturing motors all are of very recent origin, and all report a demand for motors in excess of the facilities for making them. At the same time the motor and its manufacture are practically in their infancy. Even in a few months most interesting and promising improvements are announced that will both

[illegible] of power they [illegible]

A New System of Multiplex Telegraphy

[illegible]

PART II

Fig. 3b illustrates an experiment made in determining a suitable form of armature; a two-point key was used to reverse the field intermittently, the armature being supplied with an independent direct current. Even with this irregular alternation of the current the motion was still continuous. Another method of preserving absolutely steady synchronism is shown in the sketch Fig. 8. It consists in providing the driven machine with a single coil armature and a multipolar field; thus arranged the armature passes through a smaller arc of the entire circle at each reversal of the field; but while the motion is steady it had the evident disadvantage that so high a speed cannot be obtained with the same number of reversals in a given time.

Such are the main features of the synchronizing device. There are numerous details which cannot be treated within the limits of a single paper. The uniform motion of distant machines is secured at rates of speed that may vary within considerable limits, and synchronism is maintained independently of the isochronous motion of any device or moving part, all the machines moving in unison with a governing motor which sets the pace for all the rest. The controlling machine may evidently be any form of direct current motor carrying a revolving pole changer.

A practically constant speed is of course necessary in any application of this device to the telegraph, but as an illustration of the variable synchronism it may be stated that in a continuous run of twenty-five hours the speed of three machines connected by a single line circuit has [illegible] only between [illegible] and [illegible] revolutions per minute. Fig. 4 illustrates a modification of the original [illegible]

[illegible]

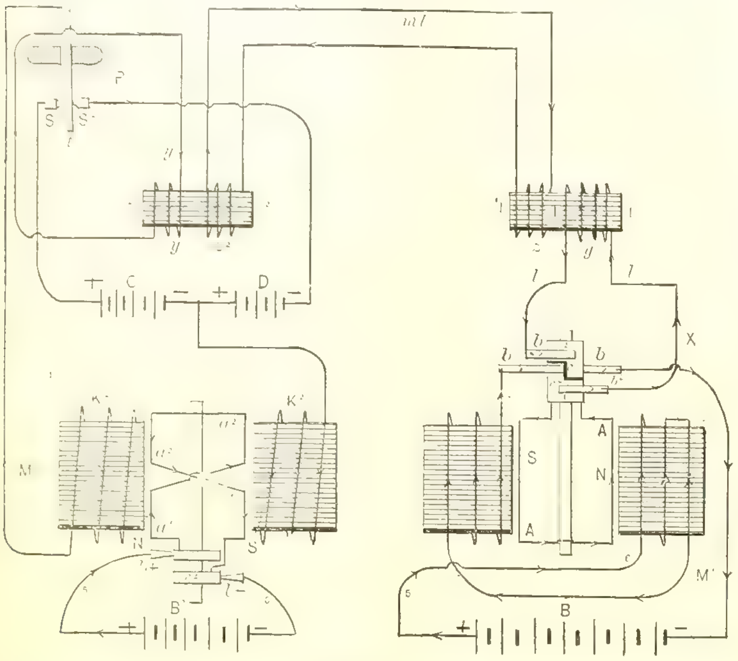


FIG. 3b.

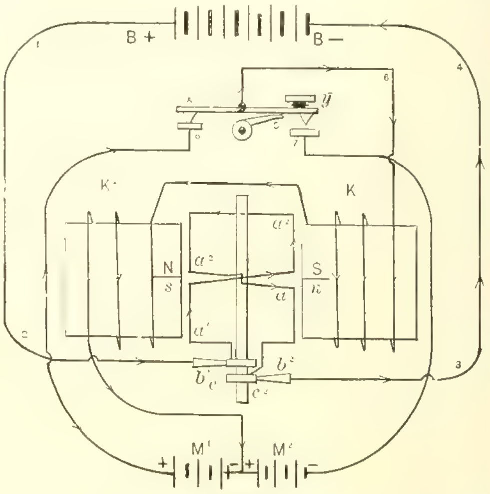
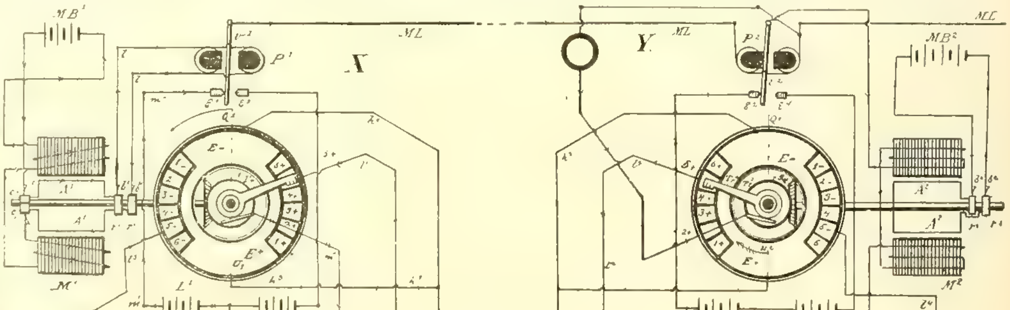


FIG. 4.



system in which induced currents of high e. m. f. are used as synchronizing currents. The armature loop of the governing machine is connected to the primary of an induction coil, the secondary to the line circuit at distant stations the impulses are reconverted and caused to actuate a polarized relay as before.

A simple experiment made to determine the accuracy of the synchronism will be explained, as it led directly to a separate application of the system to the transmission of signals. The connections are shown in Fig. 9. From the battery B a line extends to the spindle of the two machines, each provided with segmental distributors of 48

synchronism at any point of the circumference, the trailers making any angle with each other as [illegible] shown in the diagram, a revolving switch had been provided which was so arranged that by turning it a wire could be moved from one segment to another and so adjust the circuit independently of the relative positions of the trailers. The [illegible] were repeatedly stopped and started again, [illegible] again into synchronism always at the same point, the wires never requiring any readjustment, establishing clearly the singular fact that the driven machine always went into synchronism at the same point and could, therefore, be made to [illegible] at any point of the distributor by a proper adjustment of the

[illegible]

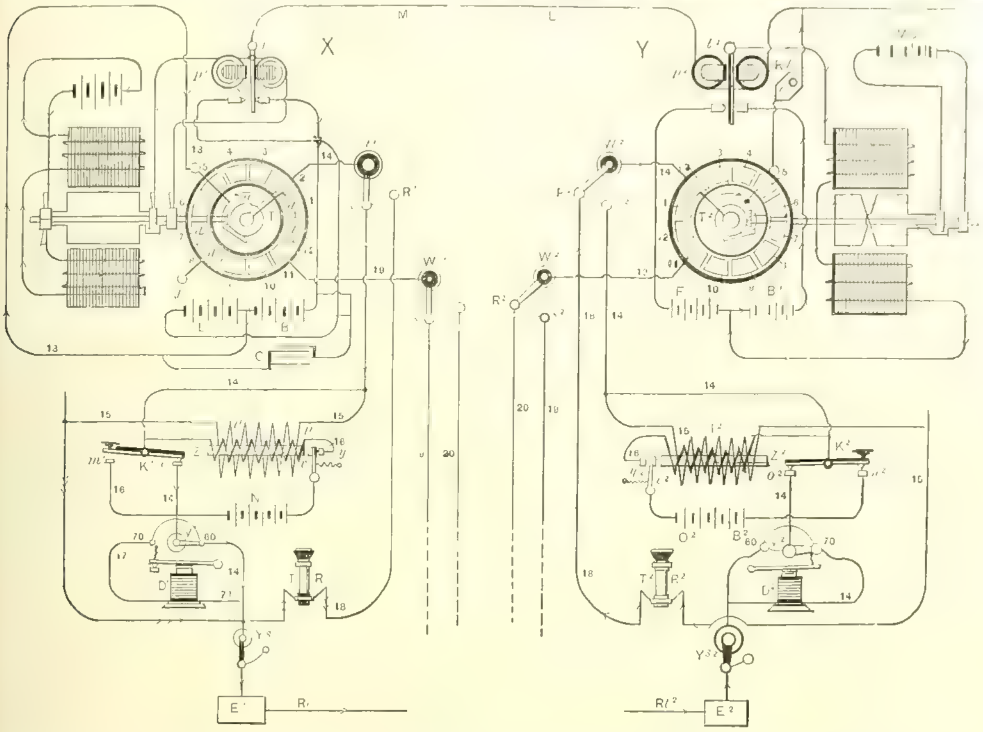


FIG. 6.

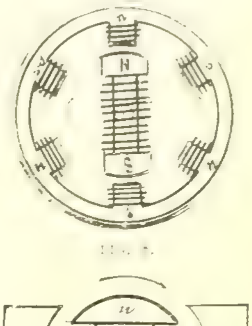


FIG. 8.

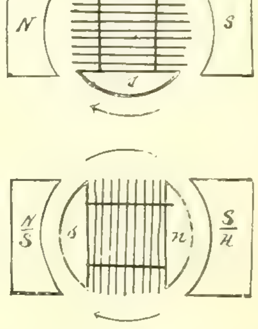


FIG. 10.

parts. From one such segment in the machine M^1 a wire was taken to a segment of the other machine, the primary of an induction coil and a key being connected in this line, the secondary of the coil was connected, as shown, to an ordinary telephone receiver. If the machines were moving in unison, the circuit of the primary would be completed whenever the revolving trailers were simultaneously upon the connected segments in the two machines, and the key was closed. If either trailer were slightly in advance of or behind the other, there could be no primary circuit formed on closing the key, no induced current, and no

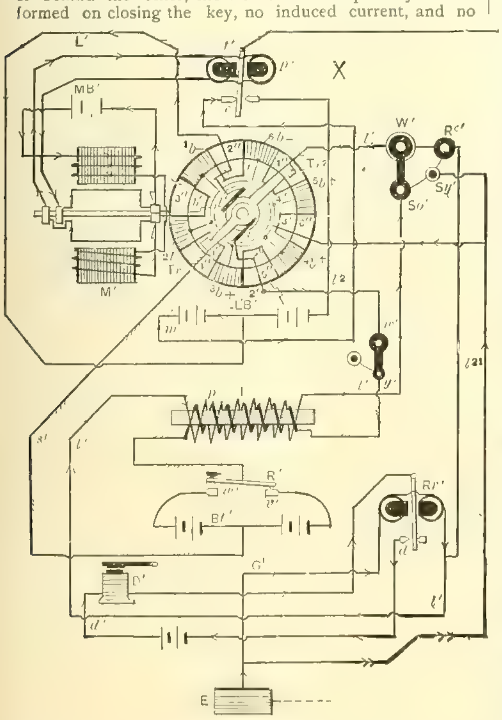


FIG. 7.

sound in the telephone. The machines were driven at variable speeds, and the wire at one machine was moved from one segment to another until the particular one was found that corresponded to the one selected in the first machine; the telephone then responded accurately to every revolution, thus proving the synchronism perfect within less than the breadth of a single segment. Other wires were then connected to other segments with a like effect.

A singular and unexpected result was deduced from this experiment. Evidently the machine M^2 might start into

trailer on the spindle. The reason for this may be found by considering the relation of the forces as expressed in the diagram Fig. 10. Here the same machine is shown with the armature in two positions differing by 90 degrees; the first is a position of maximum effort, while the second is a minimum as the field poles are changing to the opposite designation indicated by the lower letters. As the machines are provided with flywheels of considerable weight, the point of maximum effort shown in the upper diagram is the one at which the machines most readily come into synchronism with each other, being the point of least opposed mechanical resistance. In Fig. 5 is shown the simplest adaptation of the synchronizing device to a system of telegraphic transmission. The motors X and Y are connected to the line $M\ L$, as shown in Fig. 2. The synchronizing current is constantly maintained upon the line and is made to serve also for transmission of signals. It will also be observed that as the armature of the relay at X puts opposite halves of the line battery to earth alternately at each half revolution of the machine at X, one-half of the circumference of the segmental distributor corresponds to the transmission of positive and the other to the transmission of negative currents to line. Thus while the trailer is sweeping over one-half of the distributor one part of the line battery $L\ B$ is connected to line and earth, and while traversing the other half of the distributor the other part of the battery will be in circuit, each in turn sending a succession of impulses of opposite polarity. Some arbitrary line as $Q^1\ U^1$, may therefore be drawn diametrically across the distributor at X, and on one side of this line positive, and on the other negative, currents will be sent to the line wire, and by making the distributors movable about its axis the line $Q^1\ U^1$ may be made to fall within the broad spaces $E+E-$. The distributor is composed of two parts, one designated $E+$, and $E-$ is connected directly to earth; the other consists of a series of insulated segments 1, 2, 3, etc., in opposite quadrants of the distributor. Whenever the trailer is on the part $E+$, $E-$, the battery has a free path to earth and line through the trailer Tr^1. The insulated segments are connected to the local branches in pairs, each local branch having at least two such segments diametrically placed in opposite halves of the distributor. The connections and instruments in circuit are alike for all the branches, and are therefore shown in detail for only one.

Each branch—say that of operator No. 5 has a double line to earth taken from opposite halves of the distributor as those shown at 5 + and 5 −. These branches are connected to a three-point switch W^1 and W^3, which may be turned to R^1 and R^2 for receiving, or to S^1 and S^2 for sending, thus throwing the key in circuit, or to Sy^1 and Sy^2 for synchronizing, thus leaving the sending and receiving apparatus out of the circuit. An ordinary reversing key is used, the relay circuit being connected to its middle point. The drawing represents station X sending and Y receiving. Thus, if the key be depressed, as at X, so that its front contact puts the line to earth, intermittent pulsations of one polarity will go to line, corresponding to the contacts made made by the trailer with the segment pertaining to this branch on the right hand side of the distributor at X, while the negative currents, corresponding to the left hand half of the distributor, will be cut out, and the corresponding relay at both stations will be actuated by currents of

connecting any branch to the main line must of course be increased to insure certainty of action; but with a sufficiently high speed few contacts will be required. In the foregoing system, the synchronizing current, which is only used as such at two points during each revolution, is made to answer for signaling purposes also.

There are of course numerous details incident to such a system that cannot be dealt with in a superficial description. Each operator's circuit being made up with a number of rapid contacts with the main line, each one of the ordinary Morse characters is necessarily made up of a number of pulsations of current, and the serious problem has been to construct a relay that would respond to these broken currents. A single polarized relay has a tendency to leave its contact during the breaks. A number of devices have been made to correct this. Fig. 6 shows by a diagram of circuits a modification of the system of single wire transmission in which superposed currents of high tension are used to actuate receiving apparatus, thus making them independent of the synchronizing current. The key is so arranged as to open and close the primary of an induction

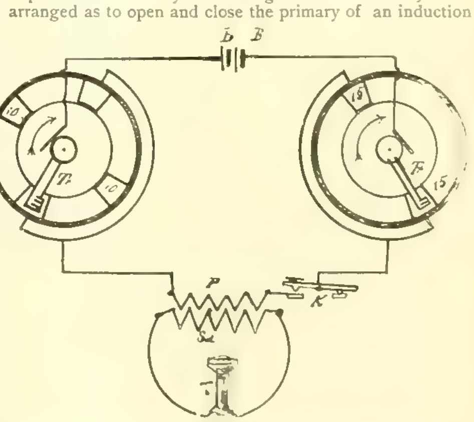


FIG. 9.

coil, the secondary of which is connected to line. A telephone or similar receiving apparatus arranged to respond to currents of high e. m. f. is connected with a receiving circuit instead of the relays. With such a system of transmission a higher order of multiplex transmission can be obtained than with ordinary receiving apparatus, and it requires so little current to actuate these instruments that each operator can work a circuit with a far less number of segments. As the trailer makes contact with any particular segment there will be of course two currents sent, due to the make and the break. In Fig. 7 is shown an arrangement by which the first of these is cut out. The primary of the induction coil connected through a separate trailer and series of segments is closed by the key before the trailer connected to the line circuit has reached its segment. The induced current due to the break only is then transmitted to line. This device is shown in Fig. 7, and

[illegible] made to work polarized [illegible] tension currents [illegible] of telegraphy will be recognized as a rather extensive one for a single paper. I [illegible] the more decisive experi[illegible] have confined the paper [illegible]. With reference to practical results on a line test I shall have more to say [illegible] best, is uninteresting, and the present one is already long. In closing, I [illegible] that may occur to many. Of what use is a system of multiplex telegraphy?

The answer is this: We live in an age of industrial advancement. People are no longer satisfied with what is good enough. They want the best. The best rail for roads must be made of steel and, this fact once established, iron was no longer suited to the requirements of travel, and iron roads have been turned into steel ones. The steel rail bears the same relation to iron in the systems of transportation that the copper wire does to the iron one in systems of telegraphic communication; the higher rate and more reliable service required demanding already in a large degree the substitution of copper for iron wires on the main lines of business. With a good copper wire and a reliable system of multiplex transmission, a single wire from New York to our principal cities would meet all the requirements of business, and it is no exaggeration to say that with these conditions given the existing system of intercommunication by the telegraph could be duplicated at a cost of one-tenth of the present amount of capital invested by either the government or private enterprises. That is what copper wire and multiplex telegraphy mean, and it is doubtless the reason why so many find the subject worthy of their best endeavors.

CORRESPONDENCE.

New York Letter.

NEW YORK, March [illegible].—A special meeting of the Board of Electrical Control was called on Tuesday last for the purpose of determining the acts and position of the United States Illuminating company, which, the mayor said, he had reason to believe was not acting in good faith with regard to the promised test cable. A resolution was read by Commissioner Gibbens, accusing the company of deliberate breach of faith, and in the course of the discussion thereon some emphatic language was used by President Lynch, who represented the company. It was a somewhat critical time for the company, which was eventually given permission to put up ten lamps in Broadway, between Twenty-third and Thirty-fourth streets, for the purpose of making the required tests.

The Board of Estimates and Apportionment yesterday transferred to the police commissioners $15,000 to enable the police wires to be put underground. This was done at the request of Mayor Grant, who said that the Western Union Telegraph company and the Metropolitan Telegraph and Telephone company had caused the police wires to be put on their poles with the evident intention of preventing the Board of Electrical Control from having the poles taken down speedily.

Now that provision has been made for placing the electric wires of the police department, as well as those of the fire department, in the subways, and the companies are recognizing the advisability of conforming to the law, New Yorkers are beginning to think that the promised carrying out of the subway system for which they have waited so long [illegible] is near at hand.

Dr. William M. McLaury read a paper on the "Seventh, or Magnetic Sense," before a meeting of the Academy of Anthropology [illegible]. Dr. McLaury prefaced his [illegible] that he followed the classification of Sir W[illegible] the sixth sense as the [illegible] that enables men and [illegible] storms even before they [illegible]. Prof. Carpenter placed the [illegible] of touch, and cites a case [illegible] temperature though [illegible] sleeping over a line [illegible] not aware of [illegible] magnetic [illegible] peculiar faculty which [illegible] [illegible]

clairvoyance, mind reading, mind cure, faith cure, prayer cure, spiritualism, etc., will be scientifically studied and rationally accounted for by the thorough and persistent investigation of the latent magnetic sense. This sense is no special gift to a few, but is latent in every individual, and is susceptible of cultivation. There is nothing supernatural in it, for there is a sufficient cause in nature for every event that ever occurred. Dr McLaury ended his paper by stating that the mere recognition of such a sense would tend greatly to increase mental development, and would add materially to the knowledge and science of to-day.

Desperate efforts are being made to bolster up the great copper syndicate which threatens to break down under the enormous weight it is carrying. An agent of the French syndicate is said to have induced the executive officers of the copper companies in this country to assent to a modification of the contract which shall secure a restriction of the output. He wished also to secure a reduction of the contract price at which the syndicate is bound to take their product, but on that point he has not been successful. Nothing definite is yet known of the result of the meeting, which took place at the Brunswick Hotel, this city, on Tuesday, between representatives of the copper companies and the copper syndicate, and which was largely attended by Boston men. There is, however, excellent reason for believing that an agreement was then entered into to limit the supply of copper hereafter, although the exact terms of the agreement are not known to the public.

The recent trials of the Vesuvius have called attention to the application of electricity to the ships of the United States navy. The first general application of incandescent electric lighting to the illumination of steamships occurred only about six years ago. It was thought for some time after that that men-of-war could not be so lighted, as the discharge of heavy guns would destroy the incandescent filaments. The Trenton was the first war vessel afloat that was lighted by the electric light. The Omaha, New Hampshire, Dolphin, Atlanta, Boston and Chicago were afterwards furnished with electric lighting apparatuses, and no new vessels are now lighted in any other way. The Chicago is the first vessel to be fitted with duplicate plants, and it is expected that electric lights can be depended upon at all times, except in action, when the plant is liable to destruction on account of its exposed position.

Besides the advantage to be derived from the lighting process to the ship, the value of the electric search lights cannot be too highly estimated. By means of these, the presence of a small boat can be detected at the distance of a mile from the war ship on the darkest night. A cruiser can anchor in the vicinity of a hostile shore, and detect on almost the instant the coming of a torpedo boat within the radius of its search flash. Then, by means of machine and rapid fire guns, the cruiser can defend herself against the smallest of foes. On some of the vessels electricity is now used to fire the guns, and whole broadsides may be fired from the tower by the mere pressing of a button.

The alleged sugar refining swindlers are at last safely lodged in the keeping of New York justice. Their lawyer, Mr. Howe, says his clients will fight the case to the bitter end, and feel confident of success. This morning Mrs. Friend reiterated to Mr. Howe that she was in possession of the secret of refining sugar by electricity, and it was not a swindle either. She also claims that she will die on the stand before she will reveal her secret. Mr. Howard promises to make some revelations that will astonish the public at large, but principally President Cotterill and Secretary Robertson.

The scheme of shortening the trip across the ocean by transporting passengers by rail across Long Island, and going aboard ship at the farther end of the island is once more under discussion. It is claimed that it will effect a saving of six hours. It is also proposed to build an electric railway for the transportation of passengers from the Eastern states to the ocean. This railway would run from Port Jefferson, on the east side, to Patchogue, on the south side, and the generating plant would be placed at Port Jefferson, where coal is cheap. P.

Kansas City, Mo.

KANSAS CITY, MO., March [illegible].—The danger of fire being communicated to a telephone switch board by leaky electric [illegible] the Kansas City exchange [illegible] the manager, W. W. Smith. [illegible] because a current [illegible] after traveling an annunciator [illegible] so that the surroundings [illegible]. In the Kansas City exchange the lines [illegible] where each is attached [illegible] wrap around a [illegible] covered with beeswax. The [illegible] current which will not [illegible] reaching the wax covered

coil, have the heat it produces retained, and the wire will melt just as it does in the annunciator magnet, but without communicating fire. There is no patent contemplated.

Dr Morrow, of the local club which is seeking to secure cheaper telephone rates, has received a letter from State Senator Williams of Indiana, in which the latter contradicts reports concerning the result of the passage of the law reducing telephone rentals in Indiana. He says: "The exchange in Indianapolis is not nearly bankrupt. It does not give very poor service. Nearly all the telephones in Southern Indiana have not been taken out because the legal rate is too low. No subscriber in Indiana ever did volunteer to pay the old rates, and if any one should volunteer to do so the agent who charged and collected it would be promptly indicted and convicted for the violation of the law. In the legislature of 1885 I introduced the bill, which passed and became the law at that session, and is now the law which fixes the rate at $3 per month when one telephone is used, and $2.50 each where two or more are used by the same person, firm or corporation. My bill was passed by large majorities in each house, and signed by the governor. It was not railroaded through, but had full consideration, discussion and investigation."

The Phœnix Iron company, of Meadeville, Pa., last week entered a suit in replevin against the National Exposition company to secure possession of the automatic electric light engine now in use in the Exposition building. The attorney for the Phœnix company stated that the engine was purchased at a contract price of $1,000, the ownership to be retained by the seller until the money had been paid. The payments are now all past due, he claims, but the Exposition company refuses to yield possession. The attorney for the plaintiff further states that the engine has been operated of late in furnishing electric light for the neighborhood. As many as 400 lights, it is said, are being furnished by the engine in litigation. The sheriff seized the engine by taking out the piston rod and removing it to his office.

At last week's special meeting of the city council an ordinance was introduced which provides that in future all unlicensed and unclaimed dogs falling into the hands of the city impounder shall be executed either by electricity or gas.

One of the largest attachment suits ever filed in the Circuit court of Jackson county was placed upon the entry docket last week. The plaintiff is E. L. Martin of this city, and the defendant is Edward S. Stokes. The suit is brought to secure a debt of $89,060, resulting from the sale of stock in the Pacific Mutual and the Pacific Telegraph companies, and garnishments were served a few minutes after the suit was filed upon the Pacific Mutual and upon George M. Myers, the former general manager. In his petition Mr. Martin alleges that on March 1, 1888, he sold and delivered to Stokes 1,056 shares of the capital stock of the Pacific Mutual Telegraph company, for which the defendant agreed to pay $89,060, of which $44,530 was to be paid on or before March 1, 1889. The defendant failed, the petition further alleges, to pay. Half an hour after the suit was filed Sheriff Sitlington had attached a promissory note for $21,159.19, held by the Pacific Mutual company, and payable to Stokes on demand.

C. S. Rusling, the Thomson-Houston company's Kansas City agent, has sold to C. H. Talmage, engineer for the Wabash & Western railway, a 40 horse power electric generator, to be used for mining purposes.

Mr. Pantaleoni of the Westinghouse Electric company of Pittsburg Pa., arrived in the city from St. Louis last week. He contracted to put an incandescent electric light plant in the works of the Kansas City (Kan.) Electric Light & Power company, situated near the Riverview station. The company now has only an arc light plant, and the new one will be put in immediately.

A company is being formed here with a capital stock of $75,000 for the purpose of putting in the Hale telephone and telegraph fire alarm. It proposes to furnish to all subscribers of telephones in the city, at an annual rental of $10, an alarm box, with which, by pulling down a hook on the right hand side, the speaker can talk directly with the fire department, and, by pulling down a hook on the left hand side, with the police department. Several of the boxes will also be placed on the streets in prominent places, without cost to the city. R.

Jefferson City, Mo.

JEFFERSON CITY, MO., March 9.—The Dempsey telephone bill reducing telephone rates to $4 a month, came up in the house for engrossment last week. Mr. Clohesy of Kansas City at once moved to amend by placing the rates at $6.25 a month. He said the reduction contemplated in the bill was too great; it would impair the efficiency of the service. The amendment was lost, and Mr. Smith of Kansas City sent up an amendment fixing the

rates at $6 a month for telephones within three-quarters of a mile of the exchange, and 50 cents additional for every additional three quarters of a mile. The amendment was voted down. Mr Smith introduced another amendment fixing the rates at $6 a month, irrespective of distance. This was also promptly voted down. Mr. Smith had another amendment ready, but Mr. Fogle moved the previous question. The motion was carried, and the bill was then sent to engrossment by an overwhelming vote. The vote showed that the bill will pass the house without doubt. Mr. Smith will propose a new amendment for the bill, and when that measure comes up for passage will endeavor to show the house that the Dempsey bill is too low, and there is danger of running down the service by the enactment of such a law. T.

St. Joseph, Mo.

St. Joseph, Mo., March 9.—The New York syndicate which has purchased the Frederick avenue and Citizens' lines of street railway, with the intention of equipping them with electricity, announces the intention of encircling the city with a single track electric line, and as a consequence a war has already sprung up between it and the Wyatt Park company.

The articles of incorporation of the syndicate have been filed, and the capital stock paid up is $800,000. An option has been obtained on the Union for twelve days, and it will probably be transferred to the People's Street Railway, Electric Light & Power company, as the new corporation styles itself. The directors have elected the following officers for the ensuing year: L. R. Bacon of New York, president; J. A. Carley of St. Joseph, vice-president and general manager; A. J. Moulton of New York, secretary and treasurer. Active operations will be commenced, and cars will be running by July 1.

The common council committee has returned from Chicago. The movement in favor of adopting the electric system of street lighting for St. Joseph prompted the trip, and it is predicted by many, will bear good fruit. The annual contract with the gas company expires May 1, hence the importance of prompt action. A majority of the common council, it is thought, will vote for electric light, if the report of the committee is at all of the nature anticipated.

The Wyatt Park Electric line has purchased of Messrs. Lucas & Co. of Kansas City the franchise of the St. Joseph Circle Cable company. It is understood that the real object of the company in making this purchase is not for the purpose of building the road, but is a move to prevent the People's Street Railway company from getting hold of it. N.

Lafayette, Ind.

Lafayette, Ind., March 9.—Considerable surprise was caused here last week upon the announcement that a receiver had been appointed for the Lafayette Brush Electric Light company. The Brush company of Cleveland held $26,000 in bonds of the Lafayette company, upon which the interest defaulted Jan. 1, 1889. These bonds are secured by a mortgage upon the property of the local company. The complaint of the Brush company of Cleveland also alleges that the Lafayette company is indebted in the sum of $25,000 to divers persons. The local company now has the contract for street lighting in this city, and it is to protect this contract, which has a year yet to run, that John W. Heath of this city was appointed receiver. R.

Fort Wayne, Ind.

Fort Wayne, Ind., March 9.—The contract for the erection of the works of the Fort Wayne Jenney Electric Light company has been let for $24,000. This amount does not include the office building—30x60 feet, two stories high. It is only intended to cover the inclosing of the main building. A considerable force of men is already engaged in cleaning up the ruins of the fire. Work on the new shops will begin at once. H.

THE ELECTRIC LIGHT.

Yorkville, S. C., will soon have a Brush system.

Bowling Green, O., will be lighted by electricity.

A Westinghouse plant will be introduced into Grand Rapids.

Jackson, Miss., was lighted by electricity last week for the first time.

William H. Evans will install an electric light plant at Frostburg, Mo.

It is proposed to light the Wabash railroad yards at Springfield, Mo., by electricity.

The Montrose, Colo., Electric Light company hopes to have its plant in operation May 1st.

The central station at Albany, Ga., was started recently, and the city is now lighted by electricity.

The Western Electric company of Chicago has just closed a contract to furnish the city of Chihuahua, Mexico, [illegible] and necessary [illegible] engines.

The Northern [illegible] company is making [illegible] electric [illegible] passenger trains.

A new [illegible] mill is projected at [illegible] to be operated in connection with the electric light plant.

The Home Electric Light company of [illegible], Colo., has decided to establish an electric light plant at once.

The [illegible], Tex., Light & Water company is [illegible] to erect an electric light plant. Machinery has [illegible] purchased.

The city council of Nashville, Tenn., has ordered the removal of the poles of the Capital Electrical company from the streets.

The Fort Wayne Jenney Electric Light company has been granted a franchise to erect and maintain its lines in Evansville, Ind.

The Hauss Electric Lighting company of Cincinnati has been granted permission to construct lines under the same conditions as the Brush company.

The United States Electric Light company have asked permission of the commissioners to lay underground conduits in the streets of Washington, D. C.

The Winchester, Va., Gas company has contracted with the city council to furnish forty street lights of 1,500 candle power, to burn every night until midnight, at $70 each per year.

The Brush Electric Light company is gaining a steady foothold in the South. In North Carolina, for instance, its recent installations aggregate 180 arc and 4,060 incandescent lamps.

The Western Electric company of Chicago has received an order for a 50-arc light plant, with engines and boilers complete, from the Capital Gas & Electric Light company of Frankfort, Ky.

The Beardstown, Ill., Electric Light & Power company—capital stock, $20,000—has been organized to furnish light, power, heat and water; incorporators, H. Ehrhardt, G. Bley and W. E. McCullough.

The city council of Thomasville, Ga., has granted the Thomasville Electric Light company the franchise for lighting the city by electricity for the term of five years, and work will be commenced on the plant at once.

The Maywood & Proviso Electric Light & Power company, at Maywood, Ill.—capital stock $20,000—has been organized to furnish electric light, etc.; incorporators, Joseph Jennings, Charles W. Kimball, Harrison P. Nichols and others.

The Evanston, Ill., Electric Light & Power company—capital stock $30,000—has been incorporated to manufacture and deal in electrical apparatus and all kinds of electric and other light, heat and power; incorporators, John Stuart Philip, John D. Adams and James L. Johnston.

F. E. Scoville has just completed an installation at the new prison at Marquette, Mich. It is the largest isolated incandescent plant in Northern Michigan, and consists of a United States dynamo driven by an "Ideal" high speed engine and operating 364 sixteen candle power lamps, and 312 eight candle power lamps.

The Grand Rapids Electric Light & Power company closed a contract recently for the purchase of a $20,000 incandescent plant from the Westinghouse Electric company of Pittsburgh. The plant will have a capacity of 2,500 incandescent lights. Four new dynamos have been ordered, each of which has a capacity of 750 lamps.

The Lansing, Mich., Electric Lighting company will engage in incandescent lighting this season. The company is negotiating for two 150 horse power engines. The new alternating dynamo is expected daily, and a large number of lights will be placed as soon as it is in position. The entire work will be completed early in the summer.

Frank and Joseph Moffatt, employes of the Chicago Arc Light & Power company, while engaged in making repairs in the conduit at the corner of La Salle and Washington streets, were overcome by gas, which had escaped from a main which runs along the conduit. Fortunately they were able to reach the manhole, and were rescued by a policeman.

Among the recent sales of the Thomson-Houston company of Chicago are the following: Granite Mountain Mining company, St. Louis, 300-light incandescent plant; O. R. Moffitt, Joplin, Mo., 100-arc light plant; Shreveport, La., Gas company, 65 arc lamps; L. J. McCormick, Lake Forest, Ill., 50-light incandescent for residence; Austin, Minn., Electric Light & Power company, 600 alternating lamps—increase.

The mayor of Richmond, Va., in his annual address, says: "The city is now under contract with the Richmond Schuyler Electric Light company for electric lights. We are using 135 of their lamps on our streets and in our public parks, which cost $144 each per annum. The contract provides that these lamps shall be of 1,200 candle power, and shall burn all night of each and every night in the year. The present contract expires in 1891, and I would earnestly recommend that the city purchase and erect a plant of its own."

A Denver paper says the same persons are interested in the Colorado Electric company and the Denver Light, Heat & Power company, and they have come to the opinion that both companies can be operated more economically as one organization than as two different companies. It is the intention of the joint corporation to extend its lines and facilities to correspond with the city's growth, and it is now engaged in making ready for 100 additional arc lights to be put at the intersection of the principal business streets, to be paid for by the city, which will be running in thirty days. The company is also adding more incandescent light facilities for use in districts in the outlying parts [illegible] company [illegible]

THE ELECTRIC MOTOR.

Electric cars will soon be in operation in Topeka, Kan.

[illegible]

[illegible] is ex-tending its lines.

[illegible] dog art belonging to a [illegible] may be seen running in the streets of Rome.

Toronto and Duluth capitalists are endeavoring to secure a franchise for an electric railroad in Kingston, Ont.

The Broadway Heights [illegible] the introduction of an electrical railway at Denver, Colo.

An electric railway will be operated between [illegible], N. Y., and Lansingburgh, Waterford, Cohoes and Green Island early in the summer.

The Dallas, Tex., Consolidated Street Railway company will probably build the electric street railroad previously reported, as contemplated by Chicago capitalists.

Omaha hopes to have its new electric railway in operation within a week. The overhead wire system ordinance was signed March 1st. Between [illegible] and [illegible] will be expended in the work of improvements and extension.

J. C. Shaffer of Indianapolis who has a twenty-two-year street car franchise in Richmond, Ind., is endeavoring to have it extended to fifty years. He wishes to put in an electric motor plant, and also to secure a franchise for furnishing electric lights.

A dispatch from St. Joseph, Mo., says: Mahlon D. Miller and Frank P. Blair of St. Paul, and L. L. Strong of this city, will build a double track electric street railway, to start from the Custom house, corner of Eighth and Edmond streets south to Sylvanie, east to Fifteenth, south to Messanic and east to Twenty-second street.

An instructive paper on "Electric Street Railways" was read before the Buffalo Electrical society recently by Frank Kitton of the Western Union Telegraph company, who described the various systems in use in this country, and compared their efficiency and economy with those of horse and steam service. He said that it was a growing belief that public demand—public necessity for a better system of street car service—will soon sway public sentiment, and that the electric motor will replace horses, even in Buffalo, probably the most conservative city in the adoption of new and advanced ideas.

THE TELEPHONE.

The Providence, R. I., Telephone company has begun burying its wires, although there was no demand on the part of citizens for such action.

An effort is being made by the Galena (Ill.) Telephone company and the subscribers to secure the burying of the electric light wires. The telephone people claim that the overhead electric light wires interfere with the operation of their lines.

The Nebraska Telephone company of Omaha contemplates building a telephone line from Norfolk to Fremont, a distance of 79 miles, and taking in nine towns. At Fremont connections can be had with the Omaha line, thus enabling all towns to talk direct with Omaha.

Another step in the Bell telephone litigation was taken February 26th in the United States Circuit court in Boston. The Supreme court having decided that the bill brought by the government against the American Bell Telephone company and Professor Bell might be maintained, thus reversing the decision of the Circuit court in Boston, sustaining defendants' demurrer to the bill on the ground of want of jurisdiction, it became necessary for defendants to plead thereto. The defendant Bell has just filed a plea in bar to the bill and an answer in support of the plea, in which he denies all the allegations of the bill which set up misrepresentations by him and fraud on his part in his application for the patent which the bill seeks to annul, and the defendant company has also filed an answer in which it makes the same denials as to misrepresentation and fraud on Bell's part, and also as to all allegations of anticipation by Reis, Drawbaugh and others. Perhaps the most interesting portion of the answer is that which sets up the decision of the commissioner of patents, [illegible] that all the proceedings in the Patent office were just, lawful, right and proper, that there was no [illegible] therein, that there was no [illegible] tion, [illegible] decision of the interference [illegible] cisions therein were right and should [illegible] stand approved, and therefore [illegible] Gray for a reopening of the interferences. The next step to be taken now is to dispose of the plea of defendant Bell, to which replication may be made and evidence taken [illegible]

A press dispatch from New York, [illegible] announced the [illegible] of Antonio Meucci, whose claims to the invention of the telephone have [illegible] [illegible]. Meucci is an Italian [illegible] friend of [illegible]. He attempted to pass his claims as

an inventor, but failed to show that he was entitled to distinction. [illegible] Wesson, of the Chicago Telephone company said in this connection that Meucci had no claims whatever. He continued: "He is too ignorant to have invented anything. By the rarest possible chance he [illegible] those talking machines that worked with a string and were quite common as toys before the telephone was made. It was said that Meucci was too poor to prosecute his suit. Any man who pretends to [illegible] immediate backing, and many have been backed before their pretensions were made. The Baltimore & Ohio railway people were behind Meucci, and went so far with him as to organize the Globe Telephone company and found a plant in New York. They were stopped at once by process of law. I do not believe that Meucci ever has been paid a cent by the Bell company. Inventors were formerly as thick as swarming bees, and each new invention was caught up by moneyed speculators, who kept up the show until they had floated their worthless stocks. Impostors are fewer now. Prof. Gray was the only plaintiff who ever had a color of claim. He undoubtedly patented the telephone simultaneously with Bell but the latter secured his rights first."

THE TELEGRAPH.

The South Florida Telegraph company has made a reduction in rates to all important points The Western Union has also reduced its rates in the state about 20 per cent. to important stations.

At a meeting of the directors of the Postal Telegraph-Cable company at New York, March 5th, the following officers for the ensuing year were elected: Albert B. Chandler, president; George S. Coe, vice-president; Edward C. Platt, treasurer; George R. Williamson, secretary and auditor; Alfred W. Kent, attorney.

Dr. Norvin Green, president of Western Union Telegraph company, in an interview published in the New York *Globe*, said: "The telegraph operators in our employ are the most intelligent body of men working for a salary in America. There are very few of our employes who are not capable of filling higher and better positions than they now occupy. They would certainly make their mark in any department of life."

A dispatch from Springfield says: "The bill of Senator Karraker, introduced in the Senate Feb. 19th, to regulate the charges of telegraph companies, fixes the following maximum rates of toll: For messages not exceeding ten words, exclusive of address and signature transmitted a distance of 350 miles or more, 20 cents, and 2 cents for each additional word. For messages not exceeding ten words a distance of less than 350 miles, 15 cents, and 1 cent for each additional word, and for repeating, 10 cents. No charge is to be made for the delivery of a message within the limits of a city. Upon a first violation of the law the fine shall be not less than $200 nor more than $1,000, and for a second offense a fine of not less than $500 nor more than $2,000. Any person from whom an extortionate charge is made shall recover ten times the amount of damage sustained."

A bill has been presented to the Pennsylvania legislature prohibiting the carrying of overhead wires in cities of 30,000 or over. A fine of $500 per day is proposed as a means of enforcing the law which, it is proposed, will go into effect August 1st. Chief Walker of the Electrical bureau, Philadelphia, however, is of the opinion that it will be impossible to take the wires down in that time. He said: "Why, it would take five years to carry out the provisions of the bill. Every one knows that I am a strong advocate of undergronnd wires, but it will take time, and no man who lived in a large city would propose a bill of that kind. It may seem incredible, but there are 12,000 miles of over head wires strung within the city limits of Philadelphia—a string of electric wire long enough to reach half way round the world, carrying a current strong enough to kill all the firemen that ever lived. There are already 600 miles of wires underground, and more are being placed as fast as possible. But to talk of burying 12,000 miles of wire in [illegible] is absurd, and it will cost $5,000,000 to do it, too "

Business Mention

The [illegible] Electric company of Chicago is introducing the Manson tape, for which it has the general Western agency.

George A. [illegible] of the Vandepoele company has just returned from the East. He succeeded in closing a contract [illegible] for 1,300 incandescent and 60 arc lamps, [illegible] for [illegible] lighting.

The [illegible] company of Chicago has gone into [illegible] especially adapted for [illegible] reduce the matter of [illegible] than the [illegible] hereto- [illegible] large or small orders on [illegible]

[illegible] of Middletown, Conn., [illegible] electric lighting [illegible] information of [illegible] other [illegible]

[illegible] company [illegible] has been [illegible] The [illegible]

[illegible]

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new edition shows careful revision and as it has been greatly enlarged it is far more valuable than the original catalogue. It contains 260 pages copiously illustrated, and contains a vast amount of valuable information for persons engaged in any department of electrical development. The work was compiled by Mr. Rentell, and reflects great credit on him.

Electrical Patents.

Issued March 5, 1889.

398,854. Electrical Tramway. Henry T. Blake, New Haven, Conn.

398,833. Printing Telegraph. Frederick H. W. Higgins, London, Eng.

398,870. Hanger Board for Arc Lamps. James J. Wood, Brooklyn, N. Y.

398,896. Electric Alarm Clock. Samuel Kahan and Albert W. Craven, Melbourne, Victoria.

398,906. Arc Lamp. William L. Silvey, Lima, Ohio.

398,907. Electric Arc Lamp. William L. Silvey, Lima, Ohio.

398,912. Method of Manufacturing Screws and Bolts by Electricity Elihu Thomson, Lynn., Mass.

The invention consists in forming the thread and shank portions of the screw separately, bringing the same into contact, passing a current of large heating effect across the joint, and then uniting the pieces by end pressure, applied while they are heated by the electric current.

398,913 Electrical Welding Machine. Elihu Thomson, Lynn, Mass.

The invention consists essentially of a power driven dynamo supplying alternating electric currents directly to an induction coil, the primary of which is of larger resistance than the secondary, while the secondary connects with the work by means of the holders

The last claim follows: "4. In an alternating current dynamo, continuous current field coils traversed by the main or working current commuted, in combination with a variable resistance around the commuting device."

398,914. Electric Metal Working and Welding Machine. Elihu Thomson, Lynn, Mass.

Rigid supports are provided, upon which the holders are supported, and the current is supplied from independent conducting pieces through a path independent of the rigid supports.

Claims 3 and 6 are given: "3. In an electric metal working apparatus, mechanical holding and moving devices for the work, in combination with current supplying devices electrically independent thereof.

"6. The combination, with the movable clamp body or support sliding in a suitable guide, of a current conveying sliding connection independent of said guide."

398,926. Electric Current Regulator. Joseph W. Balet, New York, N. Y.

398,927. Electric Current Regulator. Joseph W. Balet, New York, N. Y.

398,963. Crossing Conduit for Electric Railways. Isaac W. Heysinger, Philadelphia, Pa.

399,019 Process of Electric Welding Charles L. Coffin, Detroit, Mich.

The process consists in placing the two articles against each other and welding the joint by simultaneously traversing such joint by an electric current and subjecting it to the action of a voltaic arc

399,052. Secondary Battery. Edward R Knowles, Brooklyn, N Y.

The invention consists in first sulphating the oxides, then pasting the same on the grids, then pickling the grids in different solutions of acidulated water, the solutions being of gradually increasing strength, and finally forming and mounting them for use.

399,054 Electric Arc Lamp. George M Lane, Asbury Park, N. J.

The object of this invention is to automatically vary the resistance in the shunt magnets proportionate to the strength of the line current, so that the carbons will be maintained at a nearly uniform distance apart so as to preserve a steady arc

The second claim reads: "In an electric arc lamp, the combination, with the magnet of high resistance placed in a derived circuit and composed of a series of sections, of the circuit closer and an auxiliary magnet in direct circuit and controlling the circuit closer to bring more or less of the resistance magnet in the derived circuit."

399,057. Interrupter for Electric Circuits. Isaac F. Lecoultre, Lausanne, Switzerland.

399,059. Electric Motor. Orazio Lugo, New York, N. Y.

The objects of the invention are stated to be to so commute the current that the tangential pull had upon the armature bobbin and their cores as they rotate past the successive field bobbins may be had at two or more radial points at one and the same time; and to so arrange the stationary and rotating commutators as to bring them into close relation, and thereby render the machine more compact

[illegible]. Couch for Applying Electrical Treatment. John [illegible] and [illegible] Norfolk, Va.

[illegible]. Dynamo Electric Machine. William L. Silvey, Lima, Ohio.

[illegible] Henry W. Smith, Newark, N. J.

[illegible] Henry W. Smith, Newark, N. J.

[illegible] The improved electric car [illegible] of a car a magnet-holder, [illegible] of non-magnetic metal arranged between the magnet and railway when the car is in operation."

399,128. Self-Winding Electric Clock Frank W. Brainerd, Chicago, Ill.

The driving or main spring of the clock movement is wound up step by step through the instrumentality of electricity.

399,134. Electric Lamp Fixture and Switch. Louis W. Dillon, North Attleboro, Mass.

399,135. Electric Switch. Louis W. Dillon, North Attleboro, Mass.

399,137. Electrical Store-Service Apparatus. Richard N Dyer, East Orange, N. J

The fifth and tenth claims are: "5. In electrical store-service apparatus, the combination of a carrier, an electric motor thereon, and a shifting commutator which is shifted by the friction of the spring or springs thereon in starting the carrier, as set forth.

"10. In store-service apparatus, the combination, with a way and carriers traveling thereon, of latches holding the carriers at their stations and electro-magnets locking such latches."

399,147. Regulator for Dynamo-Electric Machines. Jesse F. Kester, Terre Haute, Ind.

399,154. Automatic Telegraphy. John O'Neil, New York, N. Y.

The claim follows: "In an automatic multiplex telegraph instrument, a continuously energized electro-magnet interposed in the main line circuit and independent intermittently energized electro-magnets in alternate circuit with said main line, in combination with styluses vibrated by said continuously energized magnet and independent electrodes in intermittent circuit with said main line circuit."

399,155. Electric Railway Signaling Apparatus. Henry J. Palmer, Brooklyn, N. Y.

An audible signal is arranged to be sounded when any one of the circuits along the line is open.

Claim 2 reads: "The combination, with conducting rails along a railway track, of corresponding contact devices upon a train, the said devices being attached to one or more movable or tilting supports, and a circuit controller operated directly by the movement of said tilting supports to close a circuit upon the train."

399,163. Electric Signal for Engine Shafts. James C. Ricketson, Milwaukee, Wis.

399,168. Electric Cigar Lighting Device. William Tag and Sanford C. Smith, Philadelphia, Pa.

399,209. Electric Amalgamator. Julio H. Rae, San Francisco, Cal

399,213. Dynamo Electric Machine. James H. Robertson, Rutherford, N. J.

The invention is designed to produce an intense magnetic field with a minimum amount of wire, and to concentrate the lines of magnetic force so that all of them will pass through the armature.

Claim 3 is given: "In a dynamo electric machine, an armature constructed of plain disks placed at intervals among a larger number of disks with projections of magnetic material, the same forming an armature having longitudinal and circumferential grooves."

399,218. Regulator for Systems of Electrical Distribution. Lewis B. Stillwell, Pittsburgh, Pa.

The invention consists in developing a normal electromotive force at the central station sufficient to supply the requisite difference of potential to the translating devices included in the circuits having the least loss or drop, and in increasing the difference of potential upon any given circuit by applying a supplemental electromotive force to that circuit sufficient to compensate for the loss or drop, or to raise the difference of potential to any required extent that may be desired for other reasons.

399,219. Method of Regulation for Systems of Electrical Distribution. Lewis B. Stillwell, Pittsburg, Pa.

The invention consists in supplying to such circuit a difference of potential of a given value, deriving from the same source an induced electromotive force approximately equivalent in value to the loss of potential upon said circuit, and in superposing such induced electromotive force upon said circuit.

399,224. Electric Regulator. Frank C. Wagner, Ann Arbor, Mich

The invention consists in a thermal conductor carrying multiple contacts and a shunt having multiple contacts located near the first set of contacts.

399,228. Circuit Closer for Railway Car Telegraphs. George I. Hopkins, Manchester, N. H.

10,989. Telephone Exchange. William B. Vansize, Plainfield, N. J. Original 393,529 of November 27, 1888.

The invention relates to multiple systems of telephone exchange, and consists in placing a series of fixed insulated contact points, equal in number to the number of circuits in a group assigned to a single operator, in close proximity to each board. The points are preferably arranged in a circle, and at the center is placed a rotating radial arm. This arm is upon a constantly rotating shaft, which also bears a wheel having a series of teeth, one for each contact point. This arm is connected to ground through a fragment of conductor containing an electro magnet and a head telephone.

The first claim reads: "The combination, in a telephone exchange, of a central station and a series of sub stations, a series of electrical conductors uniting said central station and sub stations, telephonic instruments at each station for the purpose of intercommunication, switching apparatus at the central station for connecting said conductors in pairs, and an automatic switch at the central station making and breaking connection with each of said conductors periodically."

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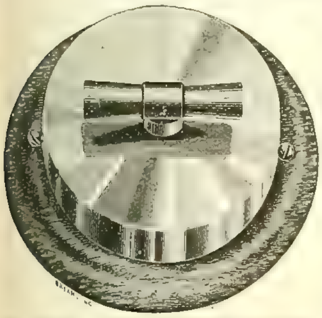

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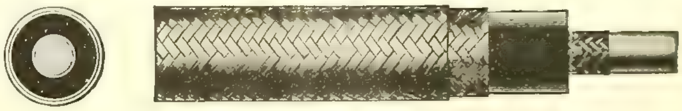

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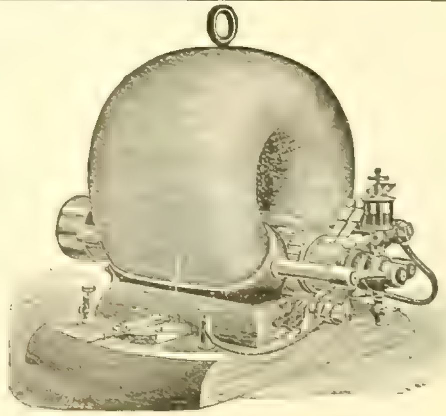

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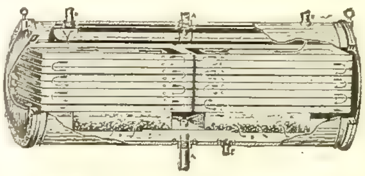

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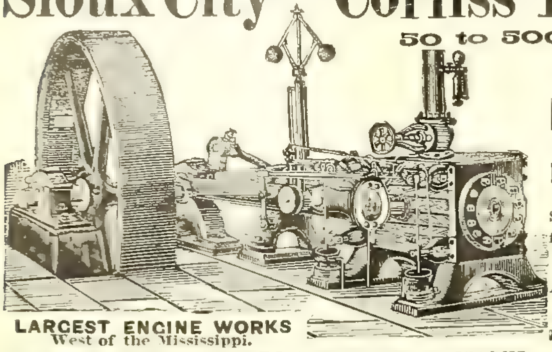

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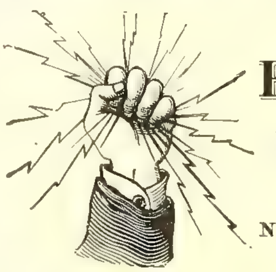

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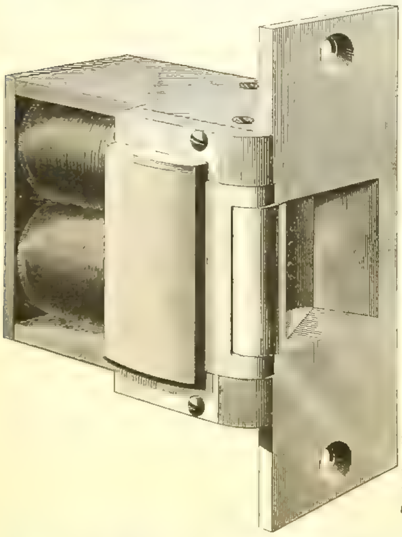

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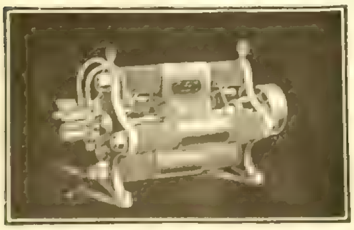

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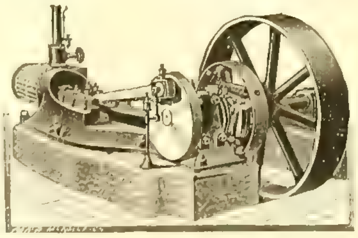

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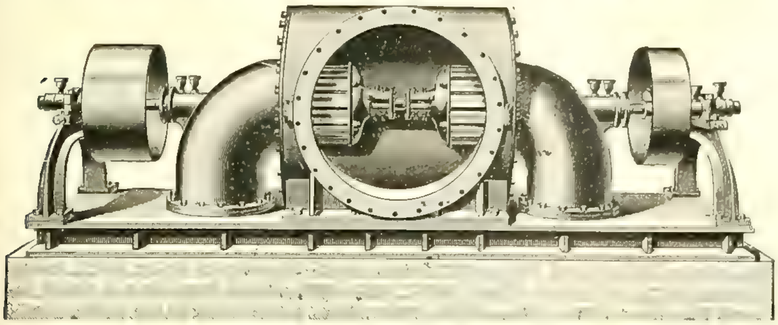

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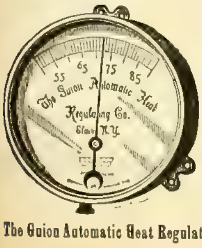

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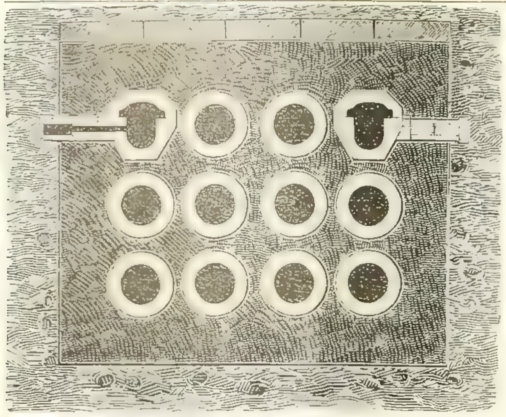

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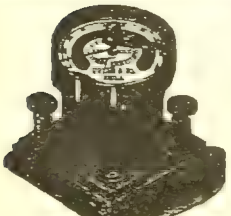

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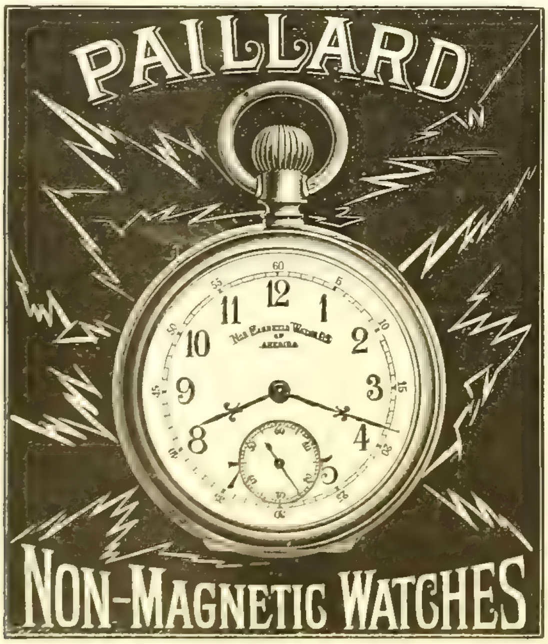

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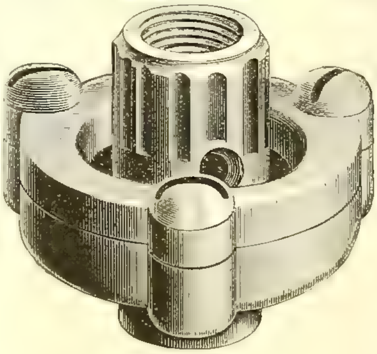

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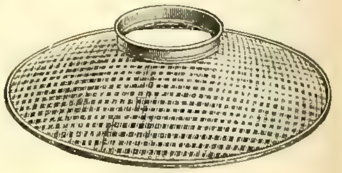

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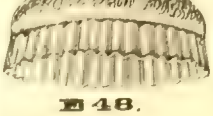

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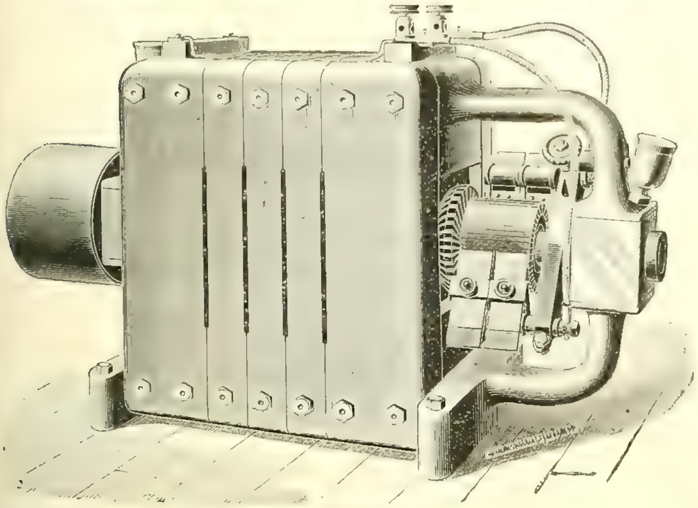

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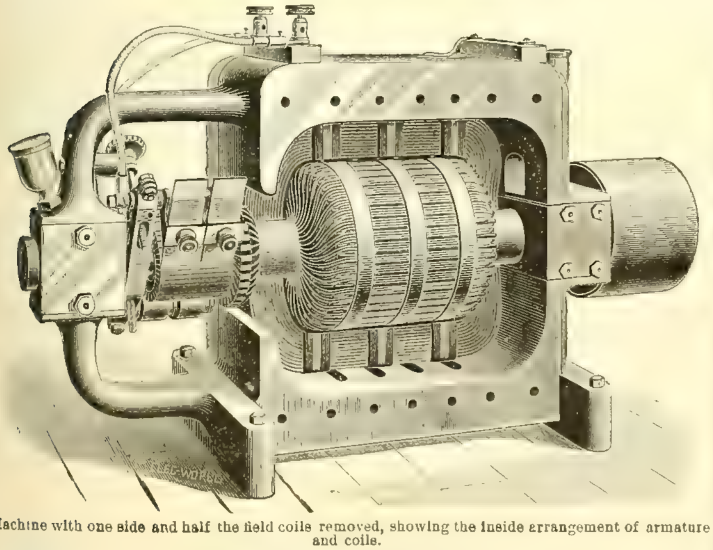

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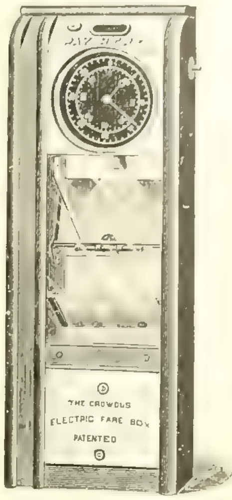

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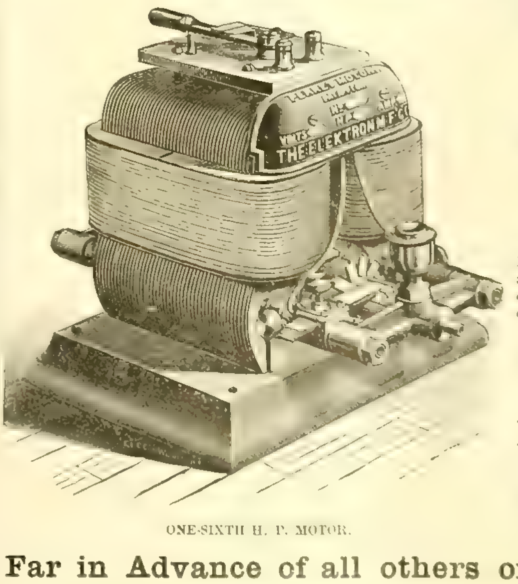

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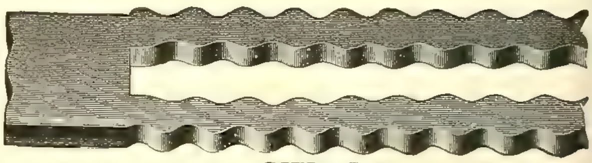

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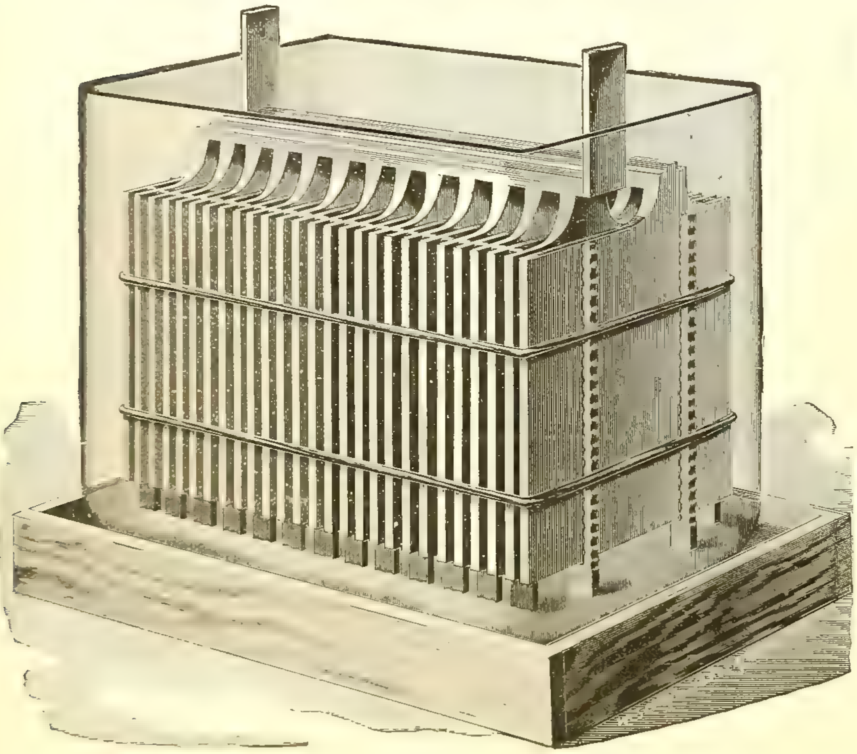

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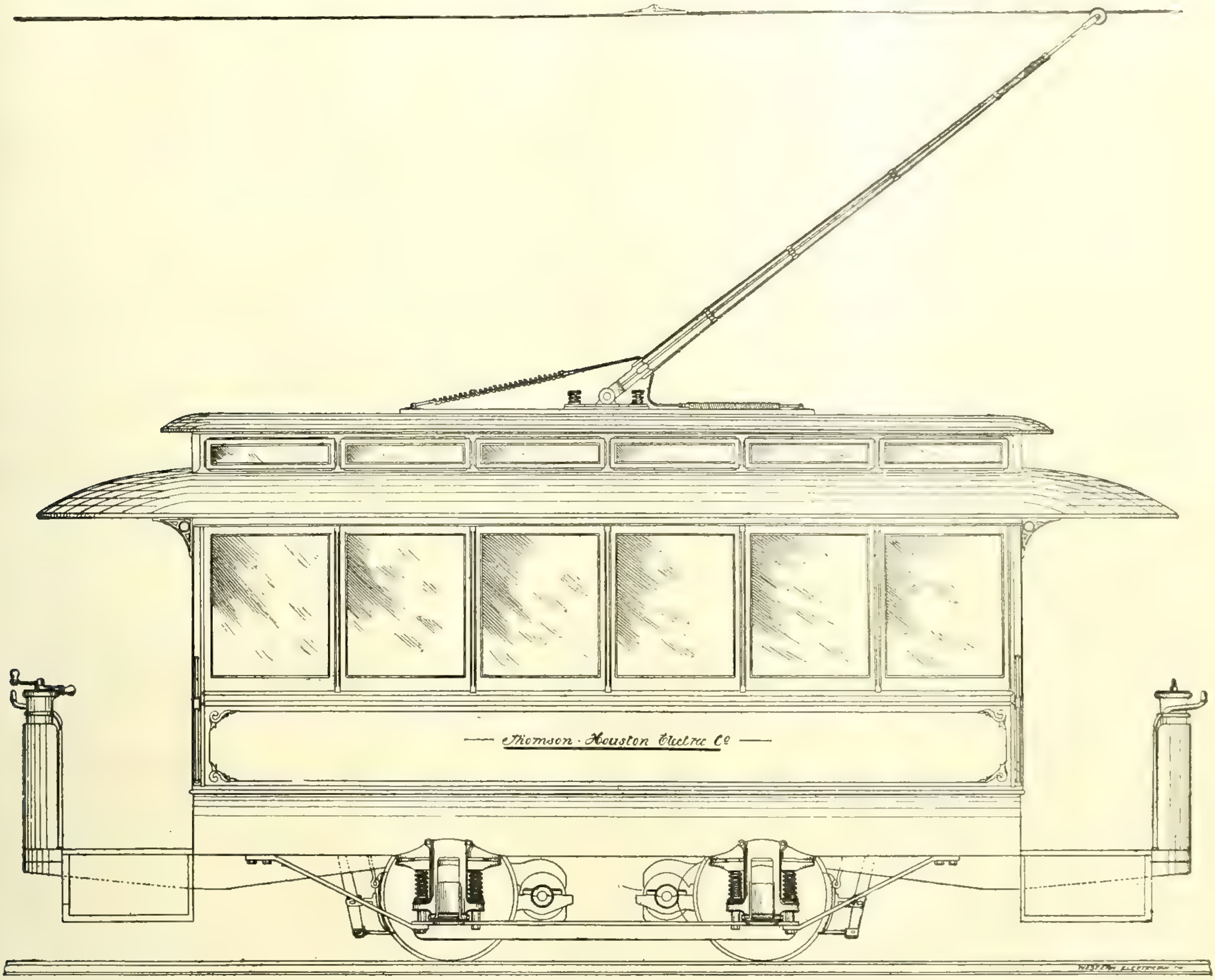

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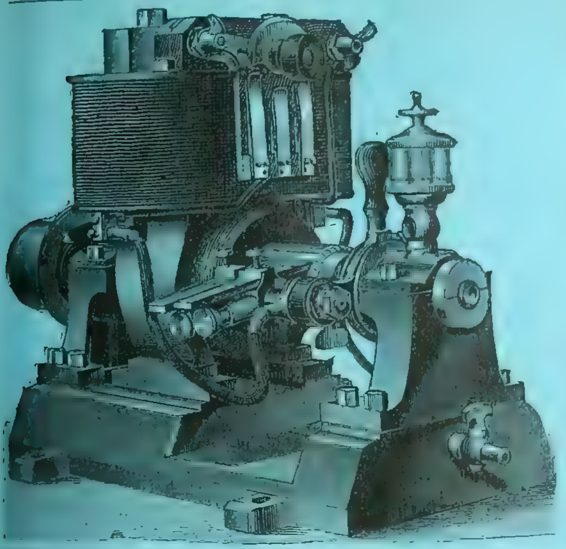

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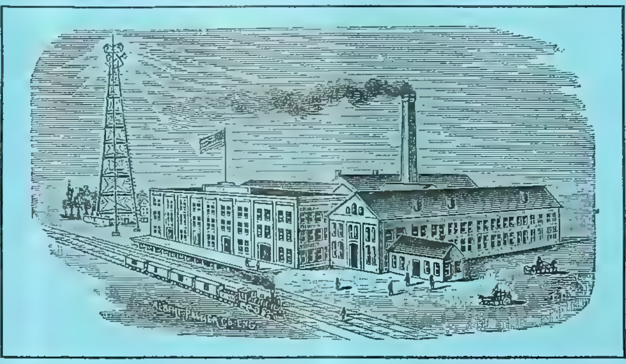

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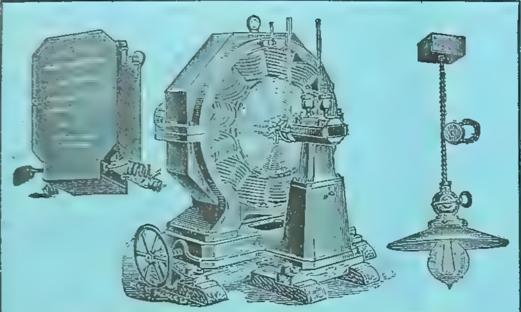

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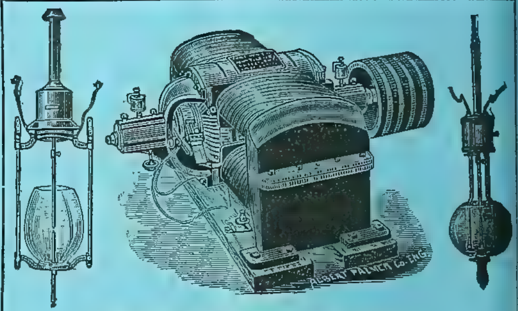

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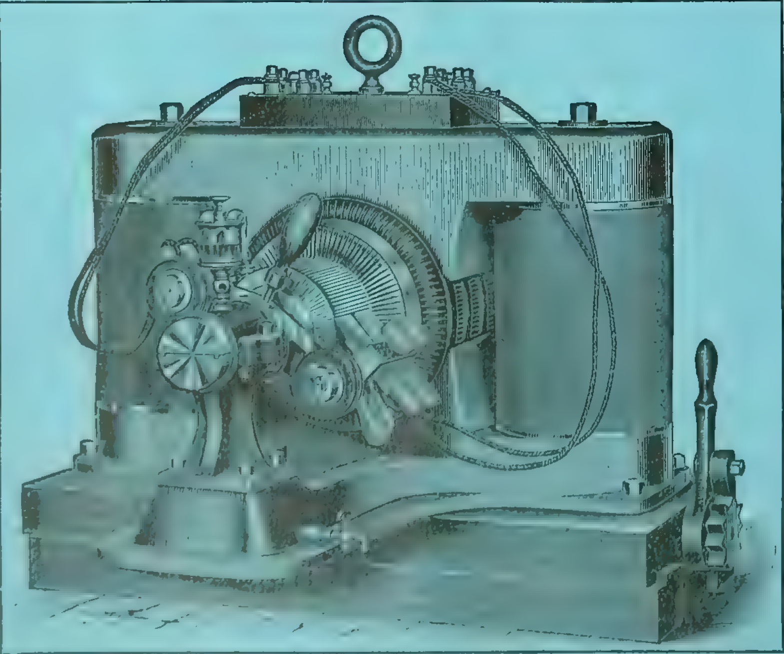

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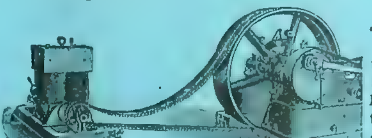

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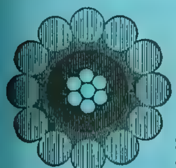

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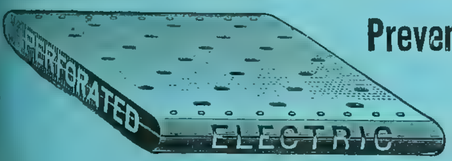

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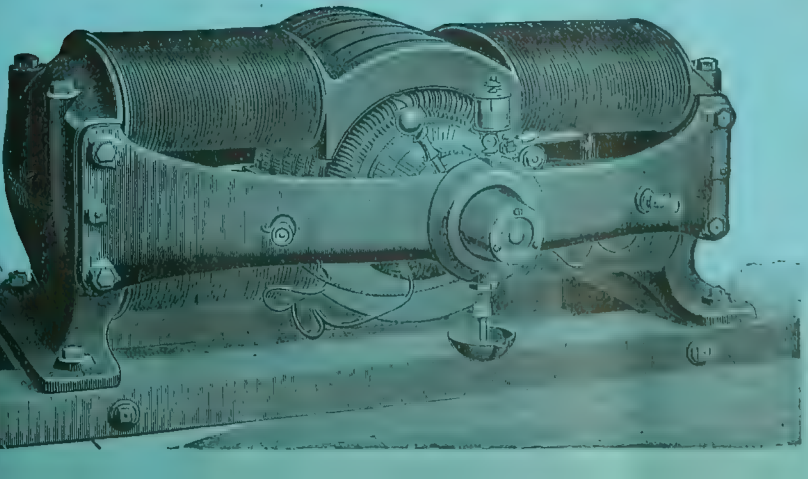

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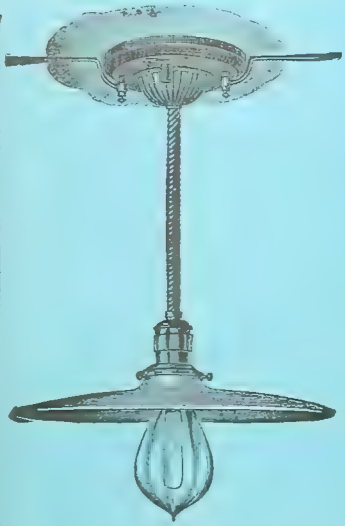

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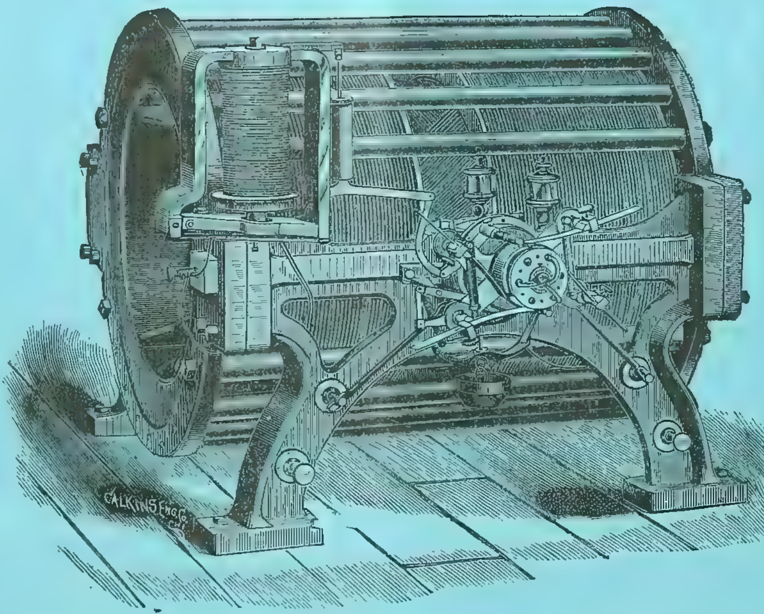

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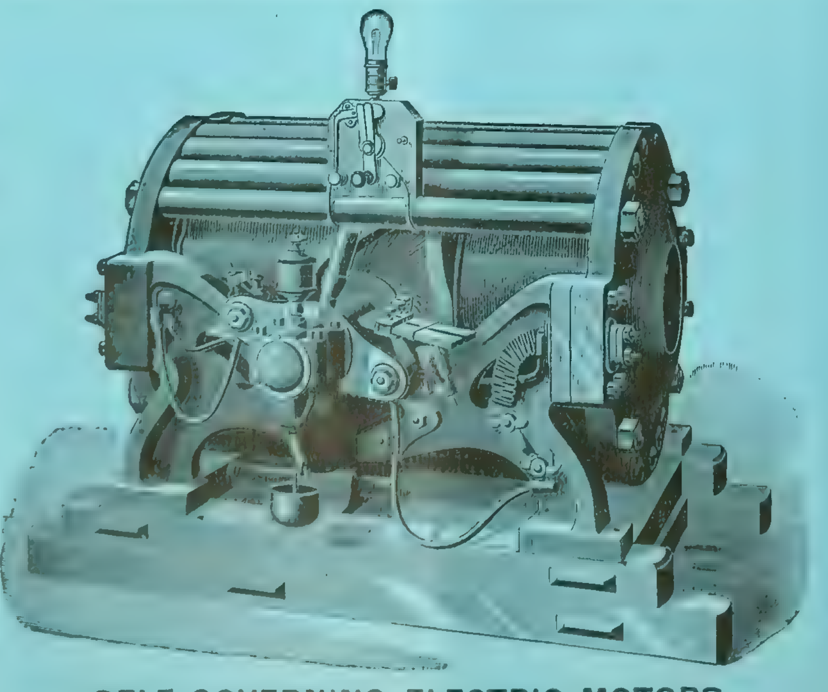

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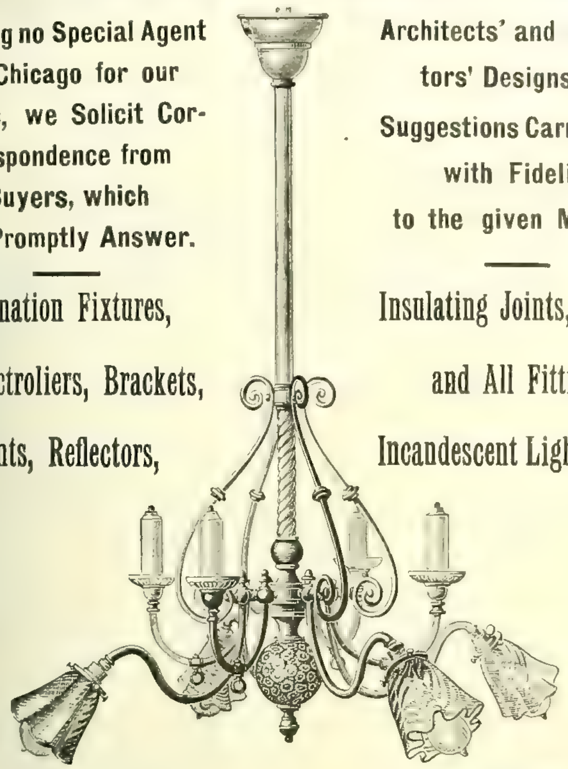

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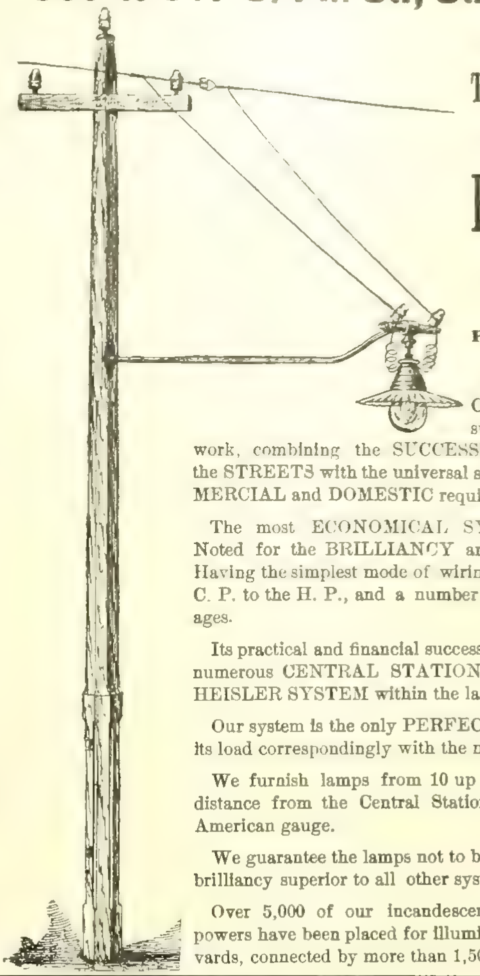

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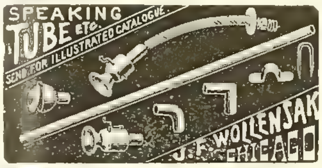

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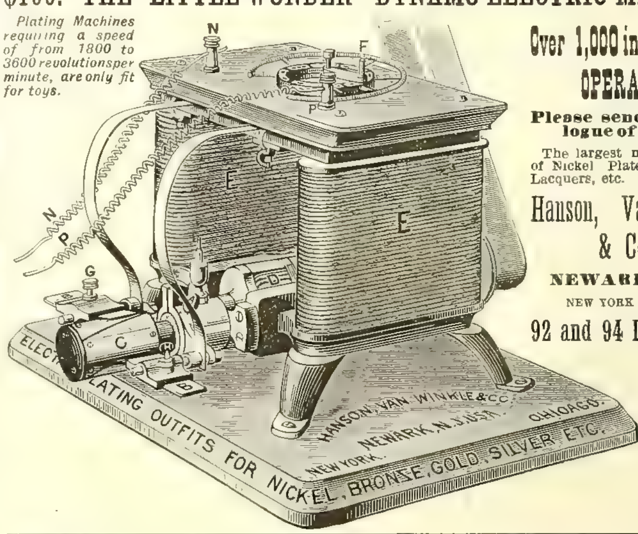

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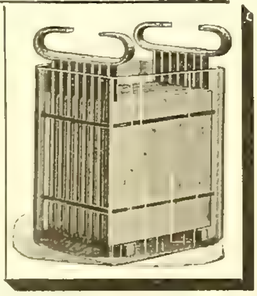

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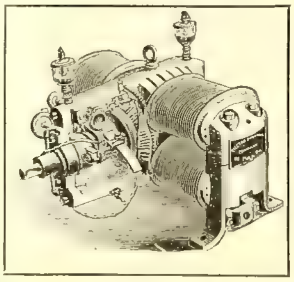

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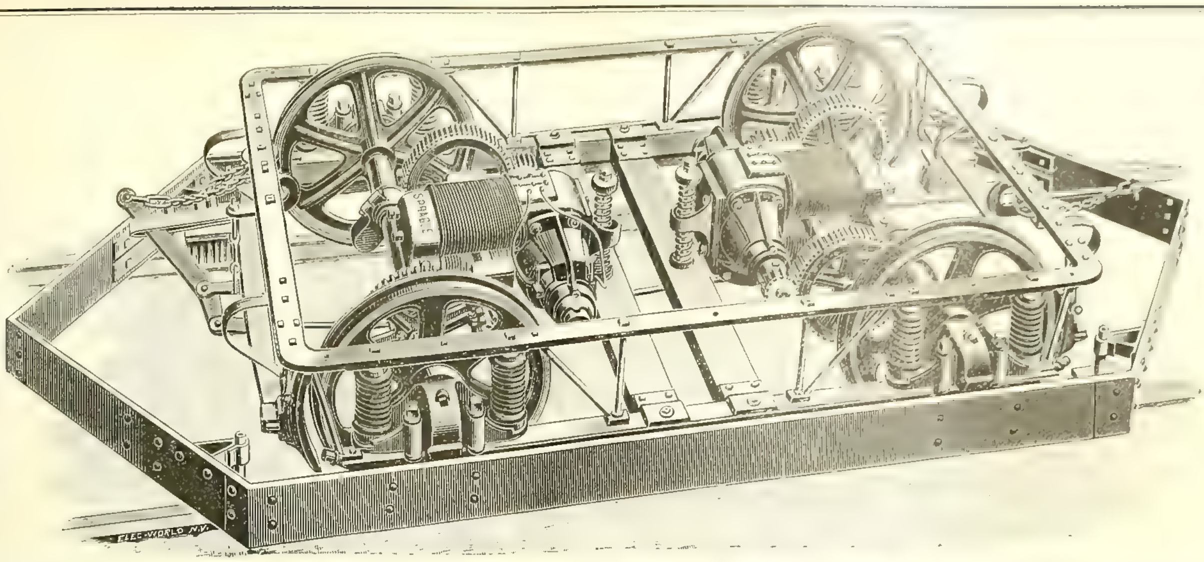

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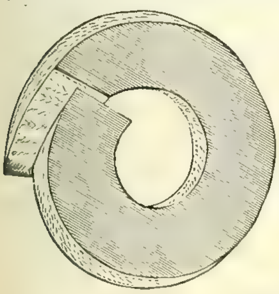

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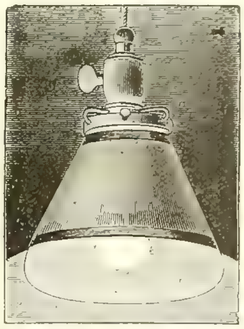

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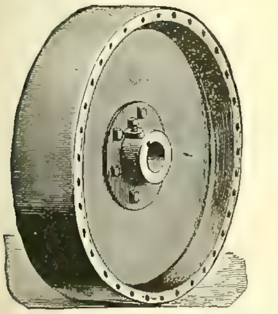

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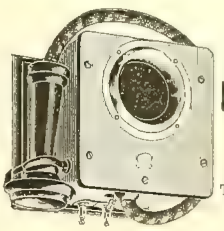

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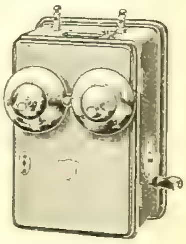

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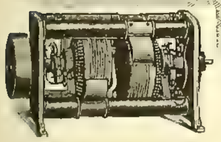

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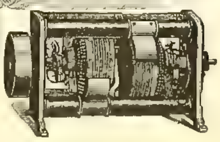

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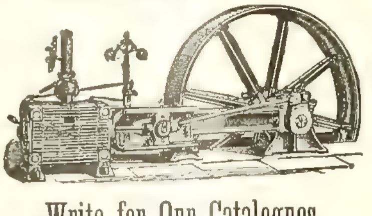

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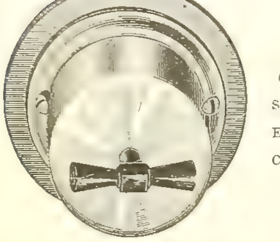

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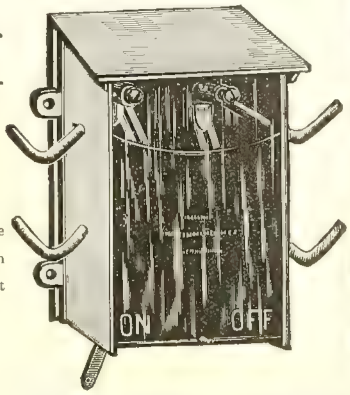

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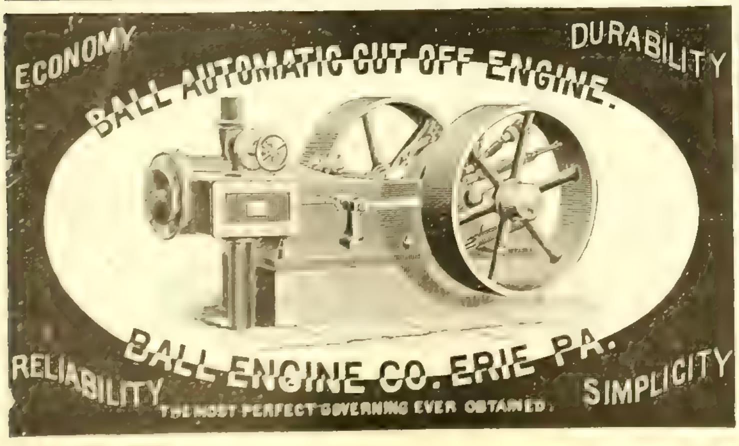

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Takes pleasure in announcing to its patrons and the general public that the decision of the Supreme Court of the United States, filed on the 21st ult., in the case of the Bate Refrigerator Company, is in fact a decision

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In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

Thus the QUESTION OF LAW having now been settled by the Supreme Court of the United States, and the QUESTION OF FACT by the highest experts of the world, this company now notifies the Public of its intention to call a halt and demand a reckoning for the trespass and abuse of its rights in

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Western Electrician.

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Vol. IV. CHICAGO, MARCH 23, 1889. No. 12

Paris Palais Royal Central Station

A view of the Edison Palais Royal Central station in Paris is shown in the accompanying cut. The installation has just been completed. In the station will be eight dynamos. They will be operated by eight independent 160 horse power engines placed in two parallel rows. They will be belted directly to the generators, as shown in the cut. The machinery is not all in position. When finished the station will have a capacity of 14,000 lights. The lamps will be employed in lighting the theaters Comedie Francaise and Palais Royal, and the stores and restaurants of the Palais Royal and several of the government offices. The cut is taken from a recent issue of *Electricite*.

St. Louis Electric Light Plant.

Work will be commenced at once on the plant to be constructed for lighting the city of St. Louis by electricity. The cost will be about $500,000. Brainerd Rorison, of the Indianapolis Jenney company, whose system will be employed for arc lighting, was in Chicago last week. He was decidedly elated over the fact that his company had secured the award. The plant, he said, could be capable of maintaining 4,000 arc lights of 2,000 candle power each, and 10,000 incandescent burners of the accumulator system. Of the 4,000 arc lights 2,226 will be used for lighting the streets, as stipulated in the contract, and 1,774 for private use in commercial buildings and elsewhere. Of the 10,000 incandescent lights more than 4,000 have already been disposed of.

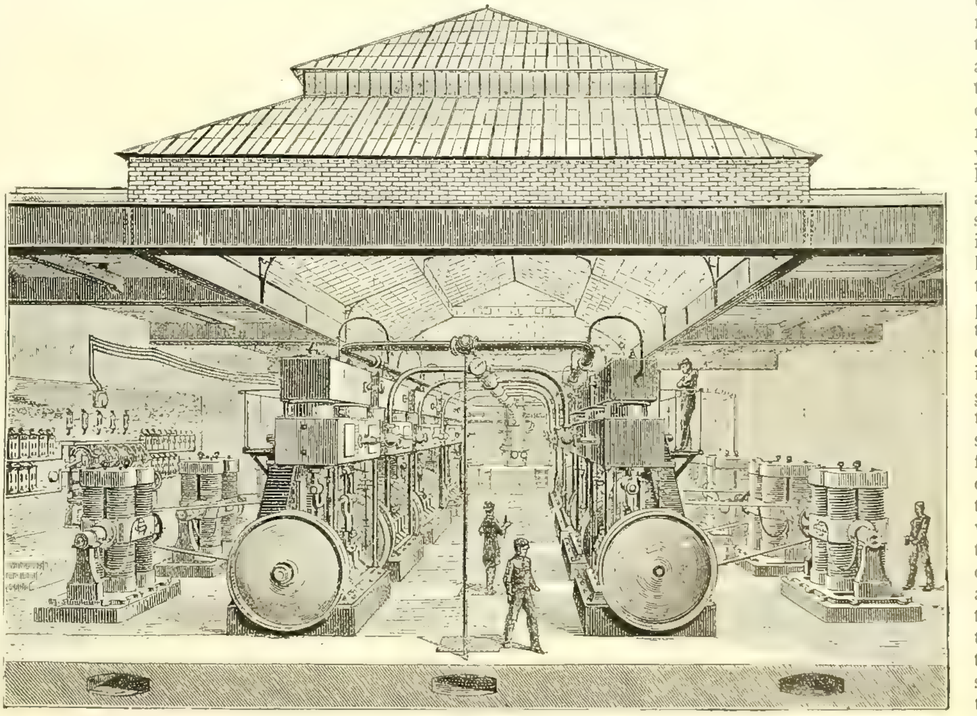
In the construction of the lines over 300 miles of wire will be used, and negotiations are now pending to supply it. Twenty miles will be placed in underground conduits, and the remainder strung overhead. The revenues from the contract with the city will be $166,439.50 a year, which, together with the receipts from private lighting, will bring about $300,000, from which the contractors expect to realize a handsome profit.

The ground for the central station has already been secured, and while the members of the company are averse to stating the exact location, it may be said that it is in a central portion of the city, and on the line of one of the large railways. This will give them every facility for handling their material without the necessity of draying it. Such an arrangement will result in the saving of a vast amount of money during construction, as well as after the plant is in working operation. The coal consumption will aggregate 100 tons per day.

The construction will give employment for eight months to 1,000 men in various capacities, and when the actual work of lighting begins 250 men will find steady work.

The Indianapolis Jenney company and the New York Electrical Accumulator company, whose respective systems will be brought into use, have already increased their capacities, and are now in a position to go to work immediately.

The whole enterprise will be under the superintendence of D. J. Harris, who is now consulting engineer and manager of the Accumulator company.



PARIS PALAIS ROYAL CENTRAL STATION

Dr. D'Unger's Telephone

Dr. Robert D'Unger of Chicago, whose telephone has already been described in this paper, expects soon to begin operations. A company is being organized, and considerable stock has been subscribed. E. J. Devens of Coldwater, Mich., who is promoting a scheme for the erection of barb wire fences, the top wire of which shall be insulated and used for a conductor, has been investigating Dr. D'Unger's instrument, and decided to utilize it. It is the intention of Mr. Devens to erect these fences along the lines of the principal railroads in the country, and use the telephones for railroad service. His scheme is to afford communication between the conductors of freight trains and principal stations. Railroad men who have been approached on this subject say the scheme is practicable, according to Dr. D'Unger, and it is represented that its adoption would effect a saving of a large amount of money to these corporations. Another scheme is to construct these fences, provided with telephone connection, in country districts, and thus enable farmers to communicate with their neighbors and those who may have business with them in the villages and cities near at hand. Moreover, Dr. D'Unger claims to have the only practicable long distance telephone in the market. He says it is not an infringement on Bell's patents, and he does not fear litigation. Although he claims to have discovered the secret of the telephone before Bell and Gray, he does not intend to prosecute his claims, but rather asserts that his system does not conflict with those in use to-day; in other words, he claims that Bell has not discovered the true secret of telephony. In proof of this he says he held communication with Milwaukee when Bell's instrument could not be operated.

It is expected that a public test of the new instrument will be made shortly at South Chicago in the presence of numerous railroad officials who are interested in the scheme.

The Copper Market.

The outlook in the copper market remains practically unchanged. If there be any change it appears to be in favor of the syndicate. The arrangement between the trust and the owners of the mines has been completed, it is said, and it is believed that the French syndicate has succeeded in securing much more favorable terms than were at first announced. The contracts with the owners of mines have been renewed for a term of ten years, the price has been lowered, and in case of an overstocked market such as the present, it is said the syndicate has the power to restrict the output for a limited period. The fact that the syndicate has succeeded during the week in making large sales at good prices indicates that it can unload its stock without loss; in fact, there appears every reason to believe that the recent sales were highly profitable to the syndicate. Moreover, it appears there is almost unlimited capital behind this gigantic trust. It has no trouble whatever in securing loans. Many times since it began operations it has been reported bankrupt, but it continues in its course, and bids fair to outlive many of the corporations that have combined for its destruction. Despite these facts, consumers continue to hope for a reduction. Many of them still believe the syndicate will be compelled to give up, and others, thinking that there will be no further advance in the market, see no inducement to invest at the present prices. A gentleman interested in Chicago copper trade said to a representative of the WESTERN ELECTRICIAN the other day: "There has been a large reduction in the consumption of copper since the price went up. Builders have been obliged to economize, and use galvanized iron for cornices, etc., where they would have used copper but for the great advance in prices. They can get along without copper, but electricians cannot. Of course they have been keeping their orders down pretty close, too, but they have to use copper, and they have to buy it. Their orders are not so large as they formerly were, but since they got accustomed to paying the advanced price there is less grumbling and kicking. I [illegible]

[illegible] prices. This syndicate has shown itself strong enough to weather a rough storm, and I believe it will control the copper market and get its own prices during the next ten years.

[illegible] says *La Bourse*, a fervent supporter of the copper ring, admits that the crisis is appalling, and announces that all mines have consented to stop their output for two months.

The following remarkable statement was issued last week by R. G. Dun & Co., on the copper market: "The great fall of copper from about £80 to £25 per ton at London appears to have come to stay. Liquidation is a confessed necessity at Paris, and consumers in this country are looking for much lower prices when contracts [illegible]."

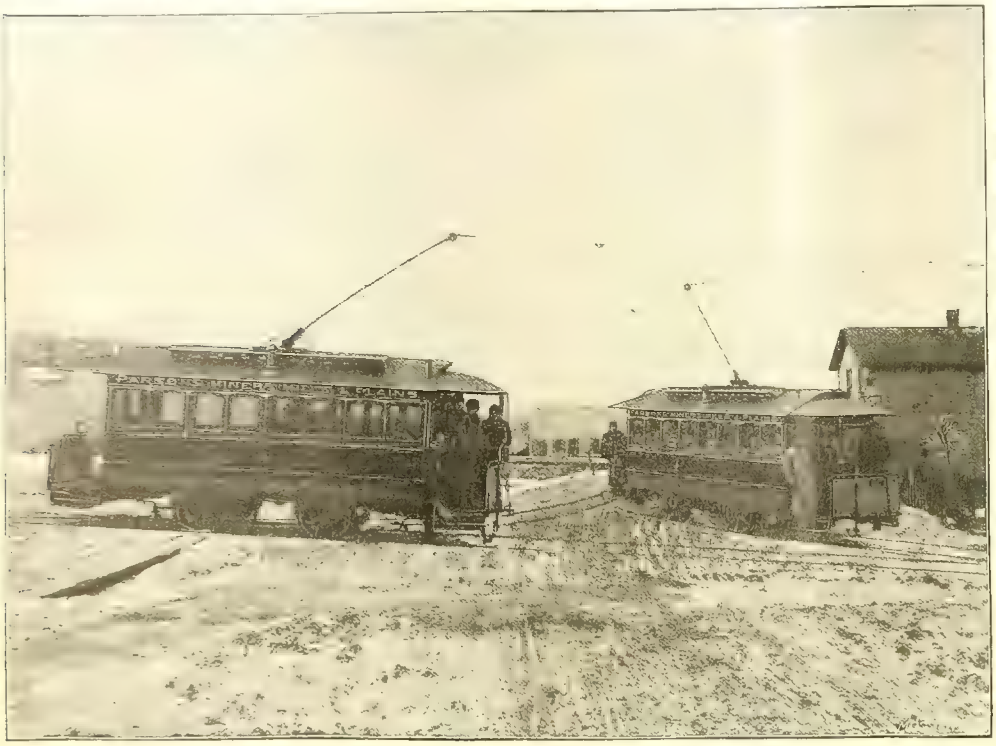


FIG. 1. SPRAGUE ELECTRIC RAILWAY AT WILKESBARRE.

The Sprague Electric Roads

In the accompanying engraving, which represents two electric cars on a Y on the Wilkesbarre & Suburban railroad, a very good idea of the Sprague method of overhead wiring can be obtained.

This road is one of the earliest which was installed by the Sprague company, and it has been in operation for about ten months. The first [illegible] three cars for operation over two miles of track, but the success of the road has been so great that the railway company [illegible] ordered a duplicate equipment from the [illegible].

Fig. 2 gives a view of a Sprague electric car [illegible] on at Steubenville, O., passing under a [illegible] the road. The [illegible] of the wide range of movement of the trolley arm, which can reach [illegible] above the car, [illegible] the location of [illegible] a wide change. [illegible] this road is extremely [illegible] supported [illegible] Sprague electric [illegible] ted by electric [illegible] Carolina rail- [illegible]

source of considerable income to the managers of the road.

System of Electrical Distribution.

A patent was granted to George Westinghouse, jr., last week, for a system of electrical distribution. The essential features are shown in the accompanying cut. The invention relates to the class of electric circuits employed for supplying currents from any convenient source of electricity to translating devices located at more or less distant points.

The object of the invention is especially to provide means for supplying the required currents transmitted over main conductors to points near the stations at which they are to be utilized, at which station electric converters are employed for transforming the currents.

In the cut *A* represents an electric generator adapted to produce alternating currents. The currents of one character are simultaneously transmitted upon a series of—in this instance three—main lines L' L^2 L^3. Simultaneously currents of the opposite character are transmitted upon three other lines, L^4 L^5 L^6. These lines are adapted to carry currents of, say, 2,000 volts each, and they extend near each other to points in the district where it is intended to use the currents for operating the incandescent lights *d d d* or other suitable translating devices. The devices are connected in circuit with two distributing conductors, l' l^2, and these conductors are supplied with other currents from the main lines through intervening converters C' C^2 C^3. The primary coil *p* of the converter C' is connected in circuit between main line conductors L' and L^4 by means of conductors 1 and 4. The converter C^2 is connected in circuit between the lines L^2 L^5 in the same manner by the conductors 2 and 5, and the primary coil *p* of the third converter, C^3, is connected by the conductors 3 and 6 with the remaining pair, L^3 and L^6, of the main lines. In this manner each converter is connected with a different pair of main lines. The secondary coils *s s s* of the respective converters are connected in multiple arc with the lines l' and l^2. The conductors L' L^2, etc., thus combine to supply the conductors l' and l^2. The conductors 1, 2 and 3, leading from the lines L', L^2 and L^3, are respectively provided with switches T', T^2 and T^3, each provided with three points, t', t^2 and t^3, respectively connected with the three lines, L', L^2 and L^3. By this means each conductor, 1, 2 and 3, may be connected with either of the three lines. The conductors 4, 5 and 6 are likewise constructed with switches T^3, T^4 and T^5, respectively. These switches are each provided with contact points t^4, t^5 and t^6, connected with the lines L^4, L^5 and L^6, respectively. Upon the interruption of the connections of any line L', L^2 or L^3, the corresponding converter, C', C^2 or C^3, connected therewith, could be connected with one of the other of the conductors upon the same side of the system, and the currents required would therefore be delivered through that main line to the converter originally connected therewith, as well as to the additional converter thus connected in circuit, the capacity of the line being such as to convey the current required more or less perfectly. In this manner if any one conductor fails, the supply of the [illegible] in such a manner that should there be any [illegible] in the connection of any given sup[illegible] conductor there will be convenient means at hand for [illegible] another supply [illegible] a path for the currents [illegible] are repaired.

[illegible] especially to electrical dis[illegible] currents are tran[illegible]

FIG. 2. SPRAGUE ELECTRIC RAILWAY AT STEUBENVILLE.

lines l l' is kept up by the other lines until the defective line is restored.

Among the claims in the patent specification are the following:

1. The combination, with a source of electricity, of multiple conductors extending from the respective poles, a series of converters having their primary coils respectively connected

FIG. 3. SPRAGUE ELECTRIC RAILWAY AT ASHEVILLE.

with different pairs of said conductors, and a single pair of distributing conductors with which the secondary coils are connected in multiple arc.

2. The combination, with a source of electricity, of two or more conductors leading from the respective poles thereof, two or more converters having their primary coils respectively connected with different pairs of conductors thus formed, and translating devices connected in multiple arc with the several secondary coils of said converters.

3. The combination, with an alternate current electric generator, of two or more main lines extending from each pole, translating devices, distributing conductors with which said devices are connected, and means for supplying currents to said distributing conductors from the different pairs of main lines.

4. The combination of a source of alternating electric currents, a series of main lines extending from each pole thereof, a series of converters, conductors including the respective primary coils of the same, switches applied to one terminal of each of said conductors, and contact points applied to each switch connected with the respective main lines leading from one pole of the source.

5. The combination of a source of alternating electric currents, a series of main lines extending from one pole thereof, a series of converters, conductors leading from said main lines and including the respective primary coils of the same, switches applied to one terminal of each of said conductors, and contact points applied to each switch connected with the respective main lines and connections from the remaining terminals of said conductors with the remaining pole of said source.

Faure Patent Sustained.

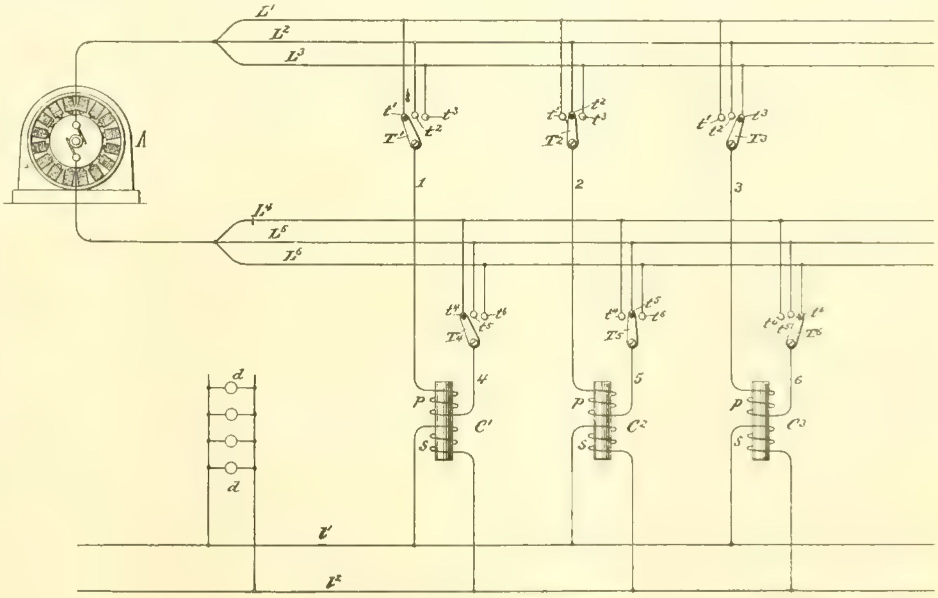
The Chicago representatives of the Accumulator company, Conant & Hood, received the following dispatch from the company last Tuesday: "Faure patent sustained for electrode with active material applied in the form of a paste, paint or cement, which are the only known methods of making practical battery plates. Injunctions will follow."

The Commercial Value of the Storage Battery.

BY [illegible]

The fine-spun theories of the experimenter and the beautiful schemes and analyses of the chemist are not appreciated when presented to the stoical man of practical business. "Will it work?" is the question that is quickly suggested by his desire to "make it pay." Whatever the invention or discovery might be—if it combined all the most ingenious devices ever devised by man, or if it were a discovery which supplied the link that would enable us practically to account for all that is or all that has been—such an invention or discovery would perish in its embryotic period unless it could be shown that in some manner or by some means it could be made of value or profit to the man of commerce. If his brother inventor was as cold, calculating and selfish as the man of business, the earth's momentum of intelligence and progress, which has been partially produced by the inventor's efforts, would be checked in its onward course of development, and if not reversed, it would at least move at a much slower speed.

The storage battery has been placed in the category of laboratory experiments, and has been



SYSTEM OF ELECTRICAL DISTRIBUTION.

[illegible]

The best storage batteries have a possible commercial efficiency of 80 per cent. [illegible] safe to subtract about 10 per cent. for loss by deterioration and neglect, the result of ignorance and rough usage. The average efficiency we may consider to be 72 per cent. This percentage is fair, and in my opinion, it may be depended upon. It may be seen, therefore, that about 70 per cent. of the useful energy of a steam engine may be stored in this way, and be utilized at will. Cable transmission can bear no comparison in point of economy to these figures. Compared with the steam engine as a transformer of energy, the storage battery is 700 per cent. more efficient.

I think there exists an unwarranted prejudice against the storage battery, and I think that the above figures will support the assumption.

One of the fundamental principles of the conservation of energy, as stated by Clerk Maxwell, is as follows: "The total energy of any body or system of bodies is a quantity which can neither be increased nor diminished by any mutual action of these bodies, though it may be transformed into any one of the forms of which energy is susceptible."

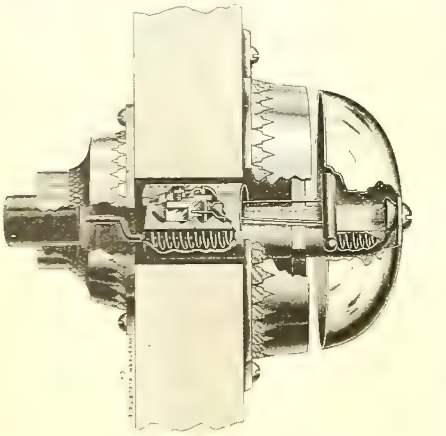
A given amount of one force produces a definite quantity of another, so that power or energy, like matter, cannot be created or destroyed; though ever changing in form or condition, its total quantity in the universe remains unaltered.

The storage battery is a means by which electric kinetics may be converted into chemical potential, and thus held until it is desirable to again convert it into electricity. In both transfers there is some loss, due to the fact that in either case a portion of the energy is converted into heat, counter-chemical action, etc. We cannot expect to realize a full measure when one form of energy is converted into another, and we must fully realize that power from the primary source is always more economical when it can be used to as great an advantage in other respects. I designate primary energy as that which is realized by the direct conversion of fuel into mechanical motion, a process which, at the present time, is employed in the most economical manner through the agency of the steam boiler and

engine, notwithstanding the small return by this means, as already described. There are places and times in which we can afford to lose 30 per cent. on account of the great conveniences of storing the energy. It may be desirable, for example, to transport energy on board railway coaches or ships, to be used in lighting while in transit, or it may be convenient to use the energy in propelling vehicles under circumstances in which a metallic connection with a generator would be difficult for many well-known practical reasons.

In the matter of street car propulsion the storage battery individualizes each car, and does not require for its operation a slot in the track or a wire overhead. The integrity of the entire system is not imperiled by a chance accident to the conductors or generators. Should one car become deranged, it can be drawn to the car house, and no interruption of the traffic ensues, as often happens "when the cable breaks," as we have seen so often on the north side, Chicago.

I would like to call the attention of the managers and stockholders of arc light plants to the storage battery as a dividend earner, and in order to enlist their confidence I quote the following: "The Municipal Gas corporation of Vienna has run for more than a year over 13,000 lights with a storage system, and without a hitch, which cannot be said of any other system of electric lighting in the world." The plant was installed by the well known electrical engineer, R. E. Crompton, who states that the batteries can be maintained for 12½ per cent. per year of the first cost.



THE FAUBER BELL.

A great many managers of arc light plants have realized lately the advantages to be derived from using their arc light plants, or a portion thereof, for furnishing power during daylight in addition to operating arc lights at night, and such managers are rewarded with increased dividends. This is a step in the right direction, but it stops short of all that can be done. A plant for supplying arc lights only, is idle, that is, not earning anything, about 75 per cent. of the time. It is a well-known fact that machinery depreciates more when idle than when in use; [illegible] storage battery system to be used in connection with an arc light system would [illegible] the value of the former by more [illegible]tant use.

[illegible] of a few thousand dollars [illegible] a few hundred [illegible] lighted with this [illegible] dynamos to charge [illegible] that the arc lights [illegible] safely estimated [illegible] lamps may be [illegible] light within [illegible] allow for suf[illegible] each day [illegible]

points where lights are wanted. The entire series may then be connected, as in the case of arc lamps. In this circuit may also be included day arc lamps and motors from each group of batteries. The usual method of wiring for incandescent lamps being observed, it will be found that the batteries are quite independent of each other, and that they are self-regulating in a higher degree even than the best shunt wound dynamos. The incandescent lamps may be used during and independent of the charging process as well as after the cells have been charged. To show the practical advantage of this system, let us consider a plant, say, of 100 arc lamps. We have, then, a watt capacity of $100 \times 450 = \frac{45000}{45} = 1000$ incandescent lamps, where 45 watts produce one 16-candle power incandescent lamp; that is to say, that a plant operating 100 arc lamps will maintain at one time 1,000 incandescent lamps. But we lose, say, 30 per cent. in conversion; therefore it will be necessary to charge, say, 30 per cent. longer time than the period during which we operate the arc lamps. The average time that arc lamps are lighted during the entire year is about seven hours per diem; therefore it would be necessary to charge the batteries about ten hours in order to maintain the incandescent lamps an average of seven hours per diem; but suppose that out of every 100 incandescent lamps, five burn all night, ten half the night, and the remainder for an average of three hours, which is the result of long experience of the gas companies. Then a plant of 100 arc lamps, by this storage system, would maintain about 1,660 incandescent lamps. Suppose each lamp will rent for $12 per annum, we would have the snug little sum of $19,970 to add to our arc light dividends, with only a slight increase in expense in daily running expenses, and this without any increased outlay for machinery and without the accompanying necessity of enlarging buildings, boilers, etc. By this system incandescent lighting may be extended to the residence portion of cities with less loss and over a greater territory than by the converter system and with a greater return for capital invested, for it is the only system of electric lighting extant, where the machinery is earning something during the greater portion of the time. Electricity is becoming a necessity in the domestic economy of our homes. A battery of, say, 25 cells located in the basement of each house to be charged by the arc dynamos from a central station will enable us to use the current in many ways, such as to ring our bells, govern the temperature of our apartments quite independently of each other, warn us of burglars, operate sewing machines, blacken our boots, purify the drinking water better than filters, grind coffee and spices, and to light every portion of the residence with the safest, most healthful and most beautiful light in existence. In the barn we may groom the horse and cut his feed by using the same agent. I hope I have convinced a few practical people that the storage battery has some commercial value, and I also hope and believe that the time is not far distant when it will become as familiar an adjunct to the present method of distribution as the dynamo.

The Book Table.

INDEX OF PUBLICATIONS ON METHODS OF COMMUNICATION IN THE FIELD AND ON TORPEDO WARFARE, by R. Von Fischer Treuenfeld. 71 pp. Published by H. Alabaster, Gatehouse & Co., London, D. Van Nostrand, New York.

In this work are published classified lists of articles relating to the application of electricity for military purposes, which originally appeared in the *Military Telegraph Bulletin.* For those who are investigating in this department this book will be invaluable. The articles are indexed under twenty-nine separate heads.

[illegible] An elementary treatise by [illegible] translated from the French by [illegible]. Published by [illegible] Spon, London and [illegible].

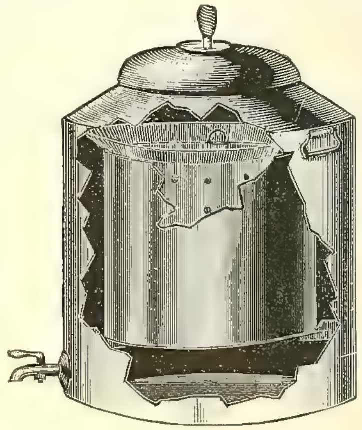
In the preface the author states that he describes in the book the practical and scientific improvements made in the [illegible] accumulator since the invention of Planté. The book summarizes [illegible] and explains the theories and [illegible] relating to secondary currents, and [illegible] applications of accumulators. The book is divided into four parts. Principles, Voltaic Accumulators, Technology, and Applications. The work is thoroughly illustrated.

The Fauber Bell.

The accompanying illustration gives a view of the Fauber bell. The button pushes in like the button of an electric bell, and operates a hammer with a double head, which strikes the bell alternately on either side. One full pressure upon the push button causes six strokes of the hammer on the bell, and a coil spring of piano spring wire forces the push button back into position, and furnishes the power for six more strokes, making twelve strokes by simply one pressure. The push button drives before it a stout wire, which pushes a steel pin through an irregular slot in a heavy brass plate. The pin is secured firmly to the pivoted end of the hammer, and as it follows the serrations the hammer vibrates and strikes its double head alternately on the bell. The barrel, which is a part of the main or foundation casting, is passed through a ⅞-inch auger hole in the door or casing, and two screws fasten the frame on the inside. The rosette is then put over the push button and two screws hold it in place. The bell is adjustable to any ordinary thickness of door, say from 1¼ inch to 3 inches. The bell is put on the market by H. H. & C. L. Munger, Chicago.

Climax Oil Filter.

The Climax oil filter, which is illustrated in the accompanying cut, will be found an economical device in electric light stations and in all plants where machinery is used. By its use oil drippings can be freed from all impurities, and the oil may be utilized a number of times. The device is put on the market by the Southwestern Electrical Supply company of Kansas City.



CLIMAX OIL FILTER.

Lightning Arrester.

A lightning arrester, for which a patent was issued to Charles H. Wilson of Chicago last week, is illustrated herewith. The invention consists of two springs placed over metal plates. The two springs are connected by a fusible wire supported upon a bead upon a frame or base in such manner that the springs are normally suspended above the underlying metal plates, one of which plates connects electrically direct to the ground, while the other connects with a return wire extending through a galvanometer, annunciator, or other indicating device and battery or generator to the line wire or direct to ground. When a strong current is sent through the connecting wire, it is fused or elongated, and the springs by their own tension are brought against their respective metal plates.

The lightning arresters may be arranged side by side upon a common base, which may be placed in the tower or in the terminal boxes upon poles. The base is preferably provided with a bead, on the opposite sides of which are placed metal plates. The fusible wire passing over this bead rests, preferably, in the slot of a metallic screw, the object of the screw being to prevent the fusible wire, when heated, from sinking into the wood, and to make more certain the fusing of the wire. The springs are held by their connecting fusible wires passing over the bead out of contact with the metal plates. When a wire

is fused or elongated, its springs close upon the underlying metal plates. The line is thus closed to ground, and at the same time the office portion of the line by a separate connection forms a complete local circuit. By means of a battery and galvanometer, either permanently or temporarily placed in the circuit with the metal strip, it may be readily determined when a wire is fused or elongated. As there are many springs over each plate, it is readily determined which particular circuit has been interrupted by the falling of the drop or signal of the particular line.

Fig. 1 is a perspective view showing a base provided with two lightning arresters embodying the invention. Fig. 2 is a diagram illustrative of the circuits.

The base *a* may be of wood, and is provided with a bead or strip, *b*, in which are inserted the screws *x*. The metal plates *c d* are placed on opposite sides of the bead, as shown, the block being preferably cut away or grooved, as shown, to afford room for the metal plates. The circuit wire *e* is connected with the spring *f* of the lightning arrester, and its normal circuit may be traced thence through the fusible wire *g* to the other spring, *h*, and thence by wire *i*, which may be a wire of a cable, to the usual spring jack, *k*, and thence through annunciator *l* to ground. The fusible connecting wire *g* may be of lead or German silver, or any fusible metal, and must be of sufficient resistance to be fused when current of undue strength is sent over the wire. The springs *f h* are so adjusted that when the connecting wire *g* is broken they will close upon metal plates *c d*, respectively. The spring *f* is made so as to possess less tension than the spring *h*, in order to insure against the former making contact with the underlying plate without the spring *h* making contact with the plate underlying the latter. Any line *e* is thus automatically connected to ground by the closing of its spring upon plate *c*. Wire *i*, which leads to the switchboard or to ground, is also closed at the same time when spring *h* closes upon plate *d*. Between strip *d* and its ground, indicating device is provided, so that when spring *h* closes upon strip *d* the fact will be shown, and the local circuit having been completed through the wire *i*, spring-jack *k*, and annunciator *l*, the latter falls and in-

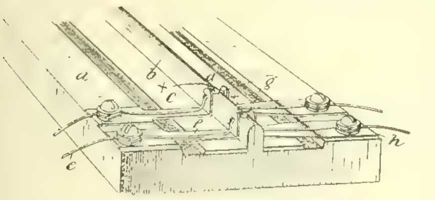


FIG. 1. LIGHTNING ARRESTER.

dicates the particular line interrupted, the galvanometer or indicating device indicating the particular location of any series of lightning arresters.

Ball and Socket Insulating Joint.

The accompanying cut shows a new insulating joint, which possesses decided advantages. It makes a perfect and uniformly gas-tight joint. The insulation is complete in every way, consisting of hard rubber washers. The following is a brief statement of its advantages: First. It admits of the perfect alignment of the fixture, as it can be adjusted to any angle within 10 degrees. Second. The flanges of each size are interchangeable. Number 1 size has ¼ or [illegible] male or female thread; number 2 size has [illegible] or ½ male or female thread. Any required combination of male or female threads can be made by substitution. Third. The joint occupies less space than any other flange joint, and its shape allows plenty of room for the passage of wires beside it. This is a valuable feature, as the space in a fixtures canopy is of necessity quite limited. Fourth. It can be put on with the tools ordinarily carried by a wireman; a monkey wrench or large pair of pliers. Pipe tongs are not required. The device is put on the market by the Electrical Supply company of Chicago.

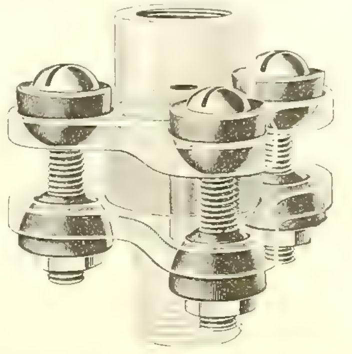
The Belleville, Ill., Citizens' Electric company, capital stock $100,000, was incorporated last week to manufacture and supply light, heat and power; incorporators, S. W. Baird, S. P. Baird and J. J. McDowell.

Detroit Storage Battery for Street Car Purposes.

Street car men at present are giving a [illegible] deal of attention to storage battery [illegible] purposes. The chief difficulty heretofore [illegible] been that it was difficult to make storage [illegible]teries do a full day's work on a road without [illegible]charging, and the recharging was [illegible] more hours than it was practicable to give [illegible] the purpose.

It will be interesting, therefore, to read the report of a test made in Detroit last week with the car Ampere on the Highland Park electric road. This car is equipped with eighty-four cells of the Detroit storage battery, manufactured by the Woodward Electrical company of Detroit, the motor being that of the Detroit Electrical works. On the Highland Park road there are two cars running by the conduit system. One of these cars, named the Franklin, was taken off the road, and the storage battery car Ampere was put in its place, and made regular trips in its stead.

The car started at the regular hour in the morning, and made a full day's run, consisting



BALL AND SOCKET INSULATING JOINT.

of eleven round trips; passengers were carried in the regular way, and a speed of eleven miles an hour was easily attained. The car made eighty miles during the day. The battery had been charged the night before, and the last trip was made at the same rate of speed as the first. When darkness came on four 16 candle power lamps were lighted from the same battery, and were run to light the car during the remainder of the experiment. Upon examining the battery the next morning it was found that the voltage of each cell was still two volts, and there was a sufficient current to have made several trips more. Both the battery and the motor were in perfect condition. A number of prominent citizens rode on the car and investigated the matter by making personal inspection, and expressed themselves as highly pleased with the results.

Frank B. Trout, the general manager of the Woodward Electrical company, is enthusiastic over the adaptability of the Detroit storage battery to street car purposes, and writes as follows:

"We are satisfied beyond any doubt that with this 300 ampere cell which we used on this car we shall be able to run regular trips of 100 miles with one charge. This makes the storage battery a practical success, as we can recharge this same battery with 300 amperes in six hours for the next day's work, and even at a higher rate of charge if necessary. The Woodward Electrical company are so well satisfied as to the durability and quality of the Detroit storage battery that we guarantee the battery for 10 per cent. per annum for the full life of our patents, namely, seventeen years. This should settle the question with street car men as to whether it is profitable to use the storage battery."

In reference to this test the Detroit *Free Press* says:

"The new car Ampere, which is equipped with storage batteries of the Woodward Electrical company pattern, was given a trial yesterday on the Highland Park railway for the purpose of testing the ability of the batteries to perform a day's service without recharging. The car was started early in the day and made ten round trips of over six miles each at an average speed of nine miles per hour without a hitch during the entire time of service. This result far exceeded the expectations of the parties interested in developing this system of propelling cars, and Manager Jackson, of the Detroit Electrical works, expressed the opinion that with the batteries fully charged a [illegible]

Underground Wires in Minneapolis.

[illegible] M[illegible] [illegible] referred to in a re[illegible] [illegible] aldermen thought this would keep the streets [illegible] [illegible] meeting of the committee of the council in charge of this matter, a resolution was [illegible] providing for the construction of a four-foot [illegible] in which eight [illegible] could be accommodated. By the passage of this resolution the committee expects to avoid the constant tearing up of the roadway, and also to make the underground wires a source of revenue to the city. This action will be reported to the council at its next meeting, and as the matter has been left entirely in the hands of the joint committee the important question of the disposition of the underground wires is considered to be practically settled so far as the city can settle it. The Dorsett conduit now occupies a portion of the trench, and the effect of the resolution is practi-

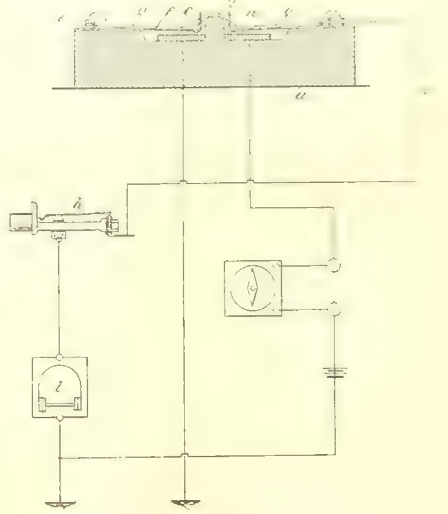


FIG. 2. LIGHTNING ARRESTER.

cally to compel the companies to put their wires in the Dorsett conduit.

Armature Coils.

The following information is given in reply to a letter of "Subscriber," Kansas City: The coils on armatures of two-pole dynamo-electric machines are usually connected in series. In the case of dynamos having more than two poles the coils, or certain sets of coils, may be connected in multiple arc. The Victoria dynamo, manufactured by the Anglo-American Brush corporation of London, [illegible] poles. Only two brushes are used, however, these standing at right angles, and half the coils of [illegible] the armature being connected in multiple arc to [illegible] the opposite quadrant. The term "series wound" [illegible] really be applied to only the armature of an alternating dynamo, the Westinghouse, for example, on which [illegible] coils are connected in series, and only the two terminals are connected to the rings of the collector.

A dispatch from Lansing says: "Supt. H[illegible] of the Lansing Street Railway company says that [illegible] company has secured control of the patent on one of the [illegible] valuable electric motors for traction purposes [illegible] Arrangements are now being perfected to equip [illegible] on the local lines of the company with the new [illegible] The tests to which the motor has been [illegible] clearly demonstrate its utility and advantages [illegible] any question as to the success of the [illegible] Its desirability as a means of street car [illegible] shown by the fact that the cost of operating [illegible] will be at least one-half less than that of any other [illegible] In the event of the success of the [illegible] Messrs. Clark [illegible] commence the manufacture of [illegible] extensive scale."

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IT will be noticed in the St. Louis letter that an electrical exhibition is to be given in St. Louis this year on a much more elaborate scale than last year.

THE bill before the Illinois legislature providing for the taxation of telegraph and telephone companies, when reported Tuesday, March 12th, was sent back to the committee on revenue, and it may not be presented again this session.

[illegible] meeting of the Chicago Electric [illegible] gave a series of interesting experiments as illustrations of his talk on handling electric light circuits. Mr. Cutter's remarks [illegible] this issue. They [illegible] the greatest interest.

[illegible] Force Bain [illegible] the storage battery, [illegible] Mr. Bain is a thorough believer in the accumulator, and he [illegible] round that it will pro[illegible] earner.

[illegible] lature pro- [illegible]

[illegible] a law. The news comes from Jefferson City that the advocates of the measure predict its passage by a large vote. A Cincinnati paper, commenting on the attempt to pass a telephone bill in the Ohio legislature, says: "The only telephone relief the Cincinnati subscribers ask from the legislature is to be let alone. They do not want the present efficient service impaired with any legislative tinkering. Their cry is: 'Let us alone.'"

MAYOR GRANT is making the lot of the electric light managers in New York anything but happy. He proposes to submit to no temporizing, but says he intends to see to it that the wires are buried without delay. It is possible that Mayor Grant may be acting with too great haste in view of the immense amount of capital invested in electric lighting in the metropolis. The executive officers of cities throughout the country are watching with keen interest the progress of events in New York, and they will not be slow to follow Mayor Grant's example. For this reason every electric light company is interested in the situation in New York. A perusal of the reports of recent meetings of the Board of Electrical Control leads to the conclusion that while Mayor Grant is conscientious his attitude is rather uncompromising, and his action rather summary.

THE copper market forms an interesting study to all engaged in electrical matters. The French syndicate maintains its position, though predictions are freely made that it cannot survive the pressure brought against it. Conflicting reports are cabled from Paris, but there appears no reasonable ground for the belief that the trust will collapse—in fact, there is every reason to assume that the French syndicate is gaining ground, and will come out of the present struggle more powerful than ever. Elsewhere will be found a review of the proceedings of the week, with the latest intelligence from the headquarters of the syndicate.

Dispatches received from Paris and London, Tuesday, indicated a growing conviction that the French syndicate was on its last legs, and would soon utterly collapse. The opponents of the trust were so firm in their belief that they had announced the downfall of the Societe des Metaux. The Comptoire d'Escompte has failed, but, it is asserted, this will not necessarily cause the collapse of the trust.

IN the *Electrical Engineer* for March appears an editorial devoted to a review of the Bate Refrigerating case. It is stated that Judge Wallace held that a domestic patent for an invention previously patented abroad for a term of fourteen years, does not expire until fourteen years from the date of the foreign patent, notwithstanding the grant might have been terminated by the failure of the patentee to pay the taxes due at the expiration of three years. The *Engineer* says that the Supreme court rejects this doctrine, and holds that the domestic patent remains in force only so long as the foreign patent remains in force. This is referred to as "a discovery which will no doubt constitute an unpleasant surprise to more than one owner of electrical patents." The *Electrical Engineer* can have full credit for this discovery. A careful consideration of the Bate Refrigerating case will show that the Supreme court has not in any way passed upon, referred to, or much less, rejected the well established rule that a domestic patent is not made void by the failure of the patentee to pay the taxes or annuities required by a foreign government to keep the prior patent alive.

The following extract from a review of the decision in the WESTERN ELECTRICIAN, February 2d, serves to make the matter clear. Judge Blatchford says: "'We are of the opinion that, in the present case, when the Canadian statute, under which the extension of the Canadian patent was granted, was in force when the United States patent was issued, and also when the patent was applied for, and where, by the Canadian statute, the extension of the patent [illegible] matter entirely of right, at the [illegible] of the patentee, [illegible] payment of a required fee, and where the fifteen years' term of the Canadian patent has been continuous and without interruption, the United States patent does not expire before the end of the fifteen years' duration of the Canadian patent.'

"The precise point decided then, is that prior foreign patents as Canadian, Austro-Hungarian, or Italian short term patents, as for five years, or one year, with right to extensions on payment of taxes, or annuities, will not make void United States patents, as long as the prior foreign patents are actually kept in force. This decision, then, is important only in those cases where the prior foreign patents have been actually extended and inferentially in cases where the United States patentee had the right to obtain such extensions in the foreign country."

THAT the North Side Cable road in Chicago has proved unsuccessful has been demonstrated by break-downs of the system, which, since its introduction, have been of almost daily occurrence. During the period in which experiments have been made with the North Side Cable, electric roads throughout the country have been built, and have without exception proved successful. The fact that street car managers in almost every city in the country, after inspecting the electric roads, express their intention of employing electric service, seems to be conclusive evidence of the success which the motors have attained. In view of these facts an interview, which appears in a western paper, with Mr. Yerkes, of the North Side road in Chicago, has a decidedly humorous character. Mr. Yerkes, after saying that he had a new style of motor submitted to him almost every day, spoke in this way of the electric system: "I don't believe it will work. As a motor power it is a toy. It acts nicely for awhile, but in our city of ice and snow, warmth and cold, it will not work smoothly. I am in hopes we will be able to use steam, and use it in such a way that the motor will be noiseless and smokeless. It is hard to get rid of the noise and condensed steam. A man in Philadelphia has been working on a plan to operate street cars by steam, and we will give it a trial when I get back." It is not surprising that Mr. Yerkes is looking for a substitute for the cable system, but it is rather astonishing that he speaks in this strain of electric motors. Let him make a fair trial of any of the electric systems, and it will be safe to predict that the residents of the North Side will not be compelled to walk to and from the center of the city as often as at present.

THE discussion of the new method of execution by electricity in New York has been revived by recent experiments made under the direction of the state officials. The final tests were made last week, and they are minutely described in our New York letter. Another feature of the new law was revived at the meeting of the Society of Medical Jurisprudence in New York city. Judge Bartlett of the Supreme court referred to the law in his able paper, saying: "Singularly enough, however, the people are not to be informed in what manner the new method works—at least not through the agency of the press. The legislature has resolved upon one of the most important changes in the method of inflicting the death penalty which has ever been attempted in any civilized country, and yet has forbidden the newspapers from publishing any account of the details of an execution under the new law beyond a simple statement of the fact that the convict was duly executed. I think the propriety of this prohibition is open to grave doubt, irrespective of any question as to the liberty of the press. Unless the circumstances attending the infliction of capital punishment by means of electricity are made known to the public, how will the community at large be able to form any intelligent judgment as to whether its lawmakers have done wisely in adopting this novel and almost untried method of putting murderers to death? The endeavor to repress publications which tend to cultivate a morbid and idle curiosity should not be carried so far as to prevent the people from readily finding out how their own laws are administered in respect to the gravest offence of which those laws take cognizance."

Practical Suggestions about Handling Electric Light Circuits.[1]

BY [illegible]

Through the kindness of Mr. Sunny in furnishing me with current from one of his street circuits, and of the Thomson-Houston company in affording me every facility for arranging the necessary apparatus, I am able to perform a few simple experiments this evening to illustrate some of the phenomena of the science of electricity, more especially that part of the science used in heavy electrical engineering work, such as electric lighting, electrical transmission of power, electric welding, etc.

The circuit is brought in to a special switch so arranged that when my inside loop is not working it is entirely separate from the main circuit. Just inside of this switch I have a lamp which has been used by the company that I work for. This lamp is so arranged that if my experimental circuit is open, a complete short circuit is formed in the lamp, and thus interference with the other lamps on the same circuit is prevented. As there are about 45 commercial lamps now burning on this circuit, you will readily understand that I cannot rnn the risk of interfering with this service. In order to know that I have not done so I have placed one of our regular series incandescent lamps of 65 candle power next to my switch, to serve as a pilot light, indicating to me that the circuit outside is working properly, and this will also show you that this external circuit is not interfered with by my operations on the inside. This loop really takes the place of the filament of the lamp screwed into my safety socket.

This circuit is connected to a dynamo, so arranged as to maintain a constant current of 10 amperes, therefore I am unable to show the effects of very heavy currents. This circuit, as before indicated, is of 45 light potential, each lamp adjusted for 45 volts. This gives us a trifle over 2,000 volts, which is a potential which must be handled with care, and I will try to call your attention to the many little movements which an experienced man is apt to make in handling such a circuit in order to know that he is taking no risks. You will notice that I do not use rubber gloves, or that I do not work on great sheets of rubber, simply because precautions of that sort are not of the right nature to guarantee safety, and I would not dare to handle these wires as I expect to this evening with rubber gloves on. The rubber is a good insulator while whole, but I should be afraid a small hole might be made while I was handling these wires, which would put me in connection at an unexpected moment, and possibly prove very serious. I therefore prefer working with bare hands whenever I handle circuits of this character, and then put myself in such a position that I cannot receive a shock.

I wish you to notice how easy it is to ascertain that you are practically safe at all times. I never assume that any wire I am handling is perfectly safe to grab hold of hastily, but touch it lightly at first, then, if I receive no shock, I proceed with handling it. Constant practice makes it so natural to "sense" a wire, so to speak, before grabbing it, that the movement is not noticed unless your attention is called particularly to it, but it is one of the most essential things to do, and get into the habit of doing, in handling electric circuits of high potential, or even heavy currents.

Another precaution is, be very careful about using both hands on different parts of the circuit at the same time, because spanning a bad joint, or any defective apparatus would be far more dangerous than merely "grounding" the circuit through the person. The e. m. f. of 2,000 volts before mentioned, only exists between the dynamo and the first lamps on the wires, therefore to receive 2,000 volts on such a circuit by a "ground" it would be necessary that one "ground" should be inside the first lamp on one wire, and the circuit be handled inside the first lamp on the other wire, and every lamp between the person and the dynamo reduces the possible potential to "ground" 45 volts, so that in the middle of the circuit the maximum potential possible would be 1,000 volts by a ground connection, whereas opening the circuit by roughly handling a bad joint, or by some sudden accident to a lamp or other apparatus, [illegible] give [illegible] probably [illegible] volts. I do not wish to convey the [illegible] that there is little danger of a "ground" [illegible] tion, as it is very serious, and must be [illegible] by all persons handling these currents. [illegible] to emphasize the fact that it is equally or more dangerous to handle the different parts of the circuit with both hands at the same time.

In handling your dynamos be sure [illegible] a platform to stand upon absolutely insulated from ground beyond any possibility of doubt. Do not consider, if the dynamo itself is [illegible] sulated, that you can handle it with safety [illegible] standing on the ground yourself, because a [illegible] insulated dynamo is more dangerous so far as shocks to the person handling it are concerned, than is one not insulated at all. Be very careful not to rest on the framework of a dynamo [illegible] one hand while touching any part of the circuit, brushes or commutator with the other. Do not put one hand on the framework and another on the field magnet wire, because although you may do this with safety many times, there is a possibility of a leak which would cause serious trouble. By observing a few such precautions there is no danger to mention in handling apparatus of high e. m. f.

I would like also to call your attention to a danger sometimes overlooked, that is, of the watch chain touching part of the circuit while you are handling another part; and also, of some person near you unwittingly touching you, thereby completing the circuit, possibly serious to one or both.

In constant potential circuits another danger must be guarded against, and that is, a heavy current produced by low resistance circuits, or what we call producing "short circuit." This is why safety fuses are used in such installations. The laws in relation to these fuses are well given in underwriters' rules. People in charge of installations should be advised of the importance of safety fuses as well as the men who construct these circuits. Every wire in the circuit of constant potential should have between it and the dynamo a safety fuse which will blow, or burn out before this wire can become dangerously hot. This is generally accomplished when the circuits are constructed, but many times they are changed by the man in charge. I have known of a good-sized copper wire being inserted in place of a lead fuse that should blow for six amperes, thereby producing a dangerous condition not appreciated by the man in charge.

As I have enumerated some points in the safe and proper handling of electric light circuits, I will now try a few experiments to illustrate some of the actions of electricity.

I have two stretches across the room of number 22 steel wire, and when I send the current through them you will notice they heat up, becoming white heat. This experiment shows the heating power of the electric current, and also gives us some idea of the cost of such heating, because in those two little stretches of wire I am now consuming about 1½ horse power. Of course if I wish to use the electric current for warming the room I would have a heavy current of low e. m. f., but the energy consumed would be about the same in either case, simply changing the size of the conductor; and for the electric radiator we would use extremely thin metal of the poorest conductibility we could find, that would not be seriously affected by the weather, as the amount of heat we develop would depend upon the resistance offered to the flow of the current, and the amount of current passing. You will also notice that my wire stretches very considerably, lowering this bunch of keys nearly a foot while heating, and raising it up again while cooling. This shows us that iron is far from being solid, but consists of molecules tossing about very lively, the extent of the motion depending chiefly upon the temperature. Electricity being a mode of motion, it so affects the motions of the molecules in the iron as to increase the temperature, and the accompanying increase in the extent of motion of these molecules causes the wire to stretch.

It is also pleasant to notice that the scientific mind of to-day can hardly conceive of a perfect solid, simply because of considerations of this sort. This shows the progress in re[illegible]

[illegible] full of water into which I insert these two car[illegible]

Next, I draw a horizontal arc between these two carbons, and you will notice the shape of it as it [illegible] considerably. This is the origin of the word "arc." Light was produced this way between two carbon points by Sir Humphrey Davy in [illegible] with a primary battery. The [illegible] of the light from a voltaic arc depends upon the length of the arc in proportion to the current and the substance which is used for the two poles. If, for instance, I use this piece of steel, you will notice how it scintillates, giving a very pretty effect; the piece of copper burns with a green flame, and this piece of zinc burns with a blue flame. There is no substance in nature that will stand the temperature of the voltaic arc. Most of the light is produced by the burning of the carbons. I now draw an arc vertically between these two carbons, adjusting one of them with this screw to show you the effect of the length of the arc. When the carbons are very close together we have what is termed a "short arc," which is constantly hissing and gives a light of a reddish tinge. This short arc gives out its best light horizontally, reducing in candle power above or below the horizontal line. For this reason and because of its reddish color, an arc of this character can be seen at a greater distance than can the long arc, but for illuminating purposes it is much less efficient in candle power per horse power. As I turn the screw and separate the carbons, you notice the change in the color and aspect generally of the arc. Now my lower carbon burns to a long point, and I have a beautiful crater in the upper carbon which furnishes most of the light. This arc gives its best effect at an angle of about 45 degrees, diminishing in candle power above or below this line, and it is because of this factor of the long arc, and its quality of burning quietly that gives it superiority under all circumstances over the short arc.

While I have this arc burning I will show you the effect of the magnet upon it. You will notice that I drive the arc out of the normal line very forcibly. This is wholly due to the mutual influence of magnetism and electricity, which influence I will show a little better very soon. Before doing so I will produce three arcs in series in this little rough frame, and pop some corn over them as a little diversion from scientific considerations. I am using the energy of 2 horse power in this arrangement.

I now try a few experiments to show you the mutual influence of magnetism and electricity—about the most interesting part of our science, and certainly the most important, because it is from such influence that we produce the electricity used in heavy engineering work. I have here a large coil, and as I send electricity through it you notice its influence upon this compass needle when at ten feet away. I have here a rubber cloth that we use for dynamo covers; to show you that I cannot screen the magnetism therewith; I also pass through and through this condition, or atmosphere, whatever you might call it, that exists between the coil and the needle, without any effect on the needle and coil, or on me. I might fill the space between the two with any non-magnetic substance in nature and still not insulate this magnetic effect. There is no substance in nature that will insulate magnetism. Some of you might take exceptions to this statement, and say that we know no substance in nature that will do this, but as we are pretty well convinced that perpetual motion is a physical impossibility, we are [illegible]

[1] Read before the Chicago Electric Club March [illegible]

[illegible] an insu[illegible] [illegible] perpetual motion very simple. To make this experiment more interesting, I move the coil into the clothes press and close the door, then tack the rubber cloth outside. I manipulate the current where the wires enter the room at quite a distance from the coil, and you will notice that my needle [illegible] the direction of the current passing in the coil in the other room. Having these two wires connected one way, the flag on the needle swings toward the coil, but changing these two wires, thereby reversing the current through the coil, I change the effect upon the needle so that the flag points away from it. As my needle is north of my coil, and, therefore, in the magnetic line, so to speak, of the needle and coil, I will use a directing magnet to make my needle point east and west. Proceeding in this same line, we could show the production of the electric current by a change in the magnetic condition, but we have no time for that this evening.

The Edison Lamp Patent Annulled in Canada.

It was stated in the WESTERN ELECTRICIAN of last week that [illegible] deputy commissioner of patents in Ottawa, had decided that the Edison incandescent lamp patent was [illegible] in Canada. The Royal Electric company of Canada was the petitioner, and the Edison Electric Light company was the respondent. The full text of the decision [illegible]:

[illegible] petition to the minister of agriculture, bearing date May [illegible], 1888, to have declared null and void the Patent No. 10,654, granted to Thomas Alva Edison, on the 17th of November, 1879, "for new and useful improvements on electric lamps, and in the method of manufacturing the same, the title whereof is Edison Electric Lamp," [illegible] of The Patent Act, Consolidated Statutes of Canada, Chap. 61, Sec. 37. On the 16th of November, 1881, an extension of three months' time within which to manufacture was granted to the patentee on his application to this effect, in which he alleged that "having been engaged in introducing his invention in other countries, he had failed in manufacturing in Canada within the [illegible] years prescribed by law, owing to the large capital which is necessary to establish such manufacture." By assignment the respondents became the holders of the patent. The petition alleged that the patentee and his assignees had not manufactured the invention within the two years prescribed by law, and that the alleged extension of three months within which to do so had been obtained by false and wilful misrepresentations; that the patentee and his assignees had imported the invention into Canada, after the twelve months allowed by law, and prayed, for these reasons, that the patent be declared null and void, and the extension above mentioned set aside and cancelled.

On the application of the petitioners, the deputy commissioner issued an order upon the respondents' counsel to produce at the trial all the invoices, accounts, letters and other documents, enumerated in a certain paper or "Notice to produce," previously served upon them, at the instance of the petitioners, in order that the same might be used as evidence, if required. By mutual consent the trial was fixed for the 13th of November, when the respective counsel, with the witnesses, being present, the case was proceeded [illegible].

The respondents' counsel, in addition to the general denial, by way of preliminary plea, took exception to the jurisdiction of this tribunal, on the ground that on the 31st of March last, and prior to the date of this petition, the respondents had taken action against the petitioners in the Superior court for Lower Canada, at Montreal, praying for [illegible] for infringement of [illegible] the petitioners did not [illegible] the action, but on the 18th of May applied for a [illegible] the decision on this [illegible] application the court [illegible]

[illegible] in effect, that the [illegible] urged as a [illegible]ion in the Superior court, under the 33d [illegible] matter of [illegible] law, [illegible] connected [illegible]

[illegible] court appeared to [illegible] that Dr. Tache had ruled in the case of the Telephone Manufacturing company v. the Bell Telephone company that the ordinary courts had not concurrent jurisdiction in this matter, but in this he was in error and [illegible] as this point did not arise in that case, there being no litigation before the courts with respect to it [illegible] to this effect was mere [illegible] and his further statement that the courts had sustained him in this view of the law, is equally erroneous—the decision in the case of Smith v. Goldie in the Supreme court reports, Vol. [illegible] p. [illegible], does not declare the jurisdiction of this tribunal exclusive, but merely conclusive, that is, where application is made to it in the first instance, and not as in the present case, where an ordinary court has already been and is seized of the case; that this is the view also taken by Justice Osler in the case of the Bell Telephone company v. the minister of agriculture, 7 Ontario law reports, p. 605, in which application was made for a writ of prohibition, to restrain the minister of agriculture from proceeding in a case then pending before him on a petition to declare null and void a patent held by that company; that Dr. Tache's ruling, therefore, should not be considered binding in the present case, and that this tribunal should not entertain the present application, but refer it to the ordinary courts constituted for the purpose, and having all the necessary powers to adjudicate upon it.

Counsel for petitioners, *contra*, that the question of jurisdiction had already been decided and pronounced upon by Dr. Tache in the case of Barter v. Smith, and in the Bell Telephone case, which was even a stronger case than this, for in that case there was not only a case pending between the parties in the High Court of Justice in Ontario, but the defendants had actually pleaded to the action, whereas in the present case the petitioners had not pleaded to the action, but on petition to that effect had the proceedings stopped until the decision of this tribunal could be had; Dr. Tache, in those cases, properly decided that there was no concurrent jurisdiction, but that this tribunal had exclusive jurisdiction to decide as to the validity of the patent in the case of importation or non manufacture, and that his decision had been sustained and approved by every court of justice that had occasion to refer to it—the Supreme court, in the case of Smith v. Goldie, and the Ontario Court of Appeal in the same case; the High Court of Justice in Ontario in the prohibition case of the Bell Telephone company, 7 Ontario reports, p. 605, in which the court held that the writ would not lie; and also in the case of the same Bell Telephone company for a writ of *certiorari* to review the decision of the Minister of Agriculture, and which the court refused to grant, on the ground that no such writ would lie, and no review could be had (9 Ontario law reports, p. 339); also the case of Mitchell v. the Hancock Inspirator company, tried before Dr. Tache, on reference from the Superior court of Lower Canada, in which the judge granted a stay of proceedings till the decision of the Minister of Agriculture could be had on the validity of the patent under the 37th section of the Patent Act; that all these decisions should be regarded as binding on the tribunal, and as settling the question of its exclusive jurisdiction in the present case.

The deputy commissioner stated that in view of the large number of witnesses present from the United States, and other places distant from Ottawa, who were naturally anxious to return to their homes as soon as possible, he would not delay the proceedings at this stage, but would render his decision of this point when judgment should be rendered on the merits of the case. The evidence was then proceeded with, lasting over three days, including an admission of facts by the parties, when the case, by agreement, was postponed to December 17th for argument of counsel, when the case was ably argued, at great length, by counsel on both sides.

The evidence adduced by the petitioners established in substance that the patent was granted to Thomas A. Edison on November 17, 1879, that on November 16, 1881, an extension of three months' time within which to manufacture was granted; that on the 12th of February, 1880 Edison assigned the patent to the Edison Electric Light company, and on the 30th of December, 1886, the latter assigned to Edison Electric Light company, the respondents. The lamp consists of a glass globe or bulb, glass tubing, inside pieces of glass, platinum and copper wires, carbon filament, and brass bottom; all these articles were imported from the United States from the time the patentee and his assignees began to make the lamps in Canada, and still continue to be imported; that the process of making the lamp from these imported articles consisted of several operations, such as attaching the carbon filament to the leading-in wires—the leading-in wires having been previously let into the glass and sealed in, the glass bulb and tube attached to it, the air exhausted from the bulb, and connection made with the brass cap or base to attach it to the socket, to connect with the circuit, supplying the electric current. On November 14, 1881, the Edison Electric Light company started a small factory in Montreal, worked by two men, and the outfit consisted of [illegible] pumps for producing the vacuum in the globes, [illegible] blowers' fires, gas fires, altogether of the value of about $2,000, and commenced the manufacture of lamps from the materials imported from the United States [illegible] and on the 17th had [illegible] the carbon filaments were put into [illegible] they were brought in from the [illegible] to any further treat[illegible] after they are in the [illegible] filaments are made of [illegible] the United States from [illegible] they were further put into [illegible] of the [illegible]

[illegible] succeed, as the men were not skilled in the work. The glass bulbs were made in the United States from pot glass, the glass blowers there blowing them, by several processes into the size and shape required. These bulbs were made expressly for use on the incandescent lamps, and must have the same expansion as the platinum, and are not ordinary articles of commerce; the glass tubing also must be made from the same quality of pot glass as the bulbs, so as to have the same expansion; the platinum wire also was specially prepared in the United States for use in the lamps. The employes were instructed not to sell the lamps to any who did not use the Edison dynamos or plant, and they accordingly did not sell them, and refused to sell to any not using the Edison plant; that it was the policy of the company to do this, as the sale of the plant was more profitable than the sale of the lamps, the proportion being that where 800 lights were installed the total price was $12,000, while the cost of the lamps at $1 each was only $800 and this had practically the effect of creating a monopoly for the Edison plant. The first sale of lamps in Canada was made to the Canada Cotton company, at Montreal, in December, 1882. The capital stock of the Edison Electric Light company in November, 188[illegible], was $720,000 or $780,000, the par value of the shares being $100, but they were then quoted and selling at from $1,000 to $1,200 per share, or a premium of $1,000 to $1,100 above par. In January, 1883, the factory in Montreal was closed and the business tranferred to Hamilton, and there increased and more men employed, but there was no change in the manner of getting out the lamps; the same articles were imported, but in larger quantities, the same steps of assembling all the parts and putting them together to complete the lamp were gone through at Hamilton as in Montreal; at this time there were about 3,800 lamps in use in Canada, and the annual output was from 8,000 to 10,000 lamps, and was gradually increasing; the proportionate cost of labor bestowed in the United States on the articles sent into Canada, to be used in the making of the lamps, is $32.50 on every 100 lamps made; while the proportion of the cost of labor bestowed on the lamps in Canada, after the importation of the articles composing it, is $21.80 per $100 worth of lamps made.

The respondents admitted the importation of the glass bulbs, the glass tubing, the platinum and copper wires, and the carbon filament, and that the importation continues still, and the evidence they adduced went to show that these were all raw material; that they were all ordinary articles of commerce, and could be used for any other purpose besides incandescent lamps; that the carbon filaments as imported were only partly manufactured in the United States, and the carbonization was completed in the Canadian factory, by the passing of an electric current through them while a high vacuum was maintained in the lamp bulbs, thereby reducing them to a pure carbon, and that this process of final carbonization was necessary to make a serviceable commercial lamp; that the glass bulbs and tubes, after they were imported, passed through several processes in the factory in Canada to render them fit for use in the lamp; that the platinum was obtained in the United States, and before being sent into Canada for use in the lamps was re-melted from the crude material, and then drawn out into wire, and slightly alloyed with iridium, so as to make it a little harder, and the wire was attached to the carbon and fitted into the glass bulbs in Canada; that if the company had been compelled to manufacture the carbons in Canada it would have ruined the business in Canada; that the platinum wire would have cost two hundred fold more in Canada, as it requires a special furnace to prepare it; that the cost of material in the United States, as imported into Canada, would be in the proportion of one-third, and the labor in Canada two-thirds.

Counsel for the petitioners argued that the evidence clearly showed that the patentee and his assignees had not complied with the provisions of the Patent Act; that they did not commence or carry on in Canada the manufacture of the invention within the time prescribed by law, and that they had imported it after the time allowed by law, and, in addition thereto, had refused to sell the invention, as they were bound by law to do; that they showed bad faith and no intention to comply with the law from the beginning, as they only started their factory and began making the lamps on November 14, 1881, a few days only before the limit prescribed by the Patent Act; then again, it is proved that at this period when they applied for and obtained an extension of time within which to manufacture, on the ground or pretension of the large capital necessary to carry on the manufacture, the capital stock of the Edison Electric Light company, the then holders of the patent, amounted to over $700,000, the par value of the shares being $100, and their market or selling price was quoted in the newspapers at $1,000 or $1,200, or a premium of from $1,000 to $1,100 above par, while it is proved that the whole capital or plant they had in Canada at this time was only $2,000, this showed their utter want of good faith, and the misrepresentation, amounting to fraud, practiced upon the Minister of Agriculture to obtain an extension of time, that they refused to sell their lamps unless in connection with their own plant, thus creating a monopoly for their dynamos or plant, which they had no right to do by law, which does not authorize or justify the imposing of conditions or restrictions upon the purchaser, as to the use of the invention when purchased by him; that the subsequent process of carbonizing the filament, after it was put into the globe and subjected to the passage of an electric current while a high vacuum was maintained, was no part of the patent, and could not be claimed for it; that the labor expended in the United States upon the articles before they were imported into Canada, on the 66,500 lamps proved to have been made up to the present time, according to the proportions of cost proved, would amount to $[illegible], which was so much loss to the Canadian laborer; and the manufacture of these lamps was increasing from year to year.

For the respondents it was contended that the patentee and his assignees had in every respect complied with the terms of the Patent Act, they had commenced the manufacture within the time prescribed by the act, and had [illegible]

imported the component parts of the lamp in the raw state, or as raw material, and ordinary articles of commerce, that there was no absolute proof that they had refused to sell, except in connection with the Edison plant, and even if this were proved it was no violation of the act, as the law did not, and could not, reasonably be construed to compel them to sell their lamps to opposition companies, who would run them on the arc or other plant, not suited to the Edison incandescent lamp, and thereby injure or destroy the reputation of the lamp; they were always willing and ready to sell to those who would do justice to the lamp, and act fairly and honestly in giving it a fair trial; with regard to importation, it is proved that the glass globes and carbon filaments could not be made in Canada, and even if they could be made it would be at such a ruinous cost and expense that the business of manufacturing the lamps in Canada would have to be abandoned; that the law did not contemplate any such unreasonable and unjust condition as this; that in any case the importation of these articles was a small matter in comparison with the cost of labor expended on the manufacture of the lamps in Canada, that, moreover, they were merely ordinary articles of commerce, and not the invention or subject of the patent, that in two cases recently decided in the Supreme court, and not yet reported, the Ayer case and the Grinnell case, in which the defendants were sued under the Customs Act, on the ground that they imported certain ingredients or articles, and afterward assembled or put them together, and manufactured an article upon which a higher duty was payable, the customs authorities claiming that they were liable for the higher duty; the Supreme court decided that the articles or ingredients were what they were when they crossed the boundary line, and were not liable for the higher duty on the article into which they were manufactured after their entry into Canada; that the imported articles in the present case could not be held to be the invention patented, and the patent could not, therefore, be delared void for contravention of the Patent Act.

DECISION.

The preliminary plea of the respondents again raises the question of the jurisdiction of this tribunal on the ground that, by the 33d and 37th sections of the Patent Act above quoted the ordinary courts of justice have concurrent jurisdiction with the Minister of Agriculture, and the Superior court for Lower Canada, at Montreal, having been first seized of the matter in dispute between the parties here, the petition should not, and could not, be entertained, the Superior court, in which the proceedings originated, being the proper tribunal to adjudicate therein. Upon reading these two sections of the act concurrently, the meaning and intention of the law seem plain, consistent and comprehensible, and admit of the sole interpretation and conclusion, that in an action at law for infringement of a patent the defendant may plead in defence any fact or default which may render the patent void; and if the defence invoke the invalidity of a patent on the ground of illegal importation or non-manufacture, this must be done by pleading the only fact which, by the 37th section, establishes it—the decision of the arbiter therein specified, the Minister of Agriculture or his deputy, whose decision being final, no other tribunal can establish such fact or default. This view was held by Mr. Taché in the decisions rendered by him, and referred to at the argument, and in which he declared the jurisdiction of the Minister of Agriculture in this matter to be exclusive; and this view or finding has been sustained by all the judicial tribunals that have had occasion to refer to it. In the case of Smith *vs.* Goldie, in the Supreme court, the summary at the head of the report, if not to be considered as of the substance and part of the report, must assuredly be accepted as a correct and accurate interpretation thereof, contains the following words in paragraph 3: "The Minister of Agriculture, or his deputy, has exclusive jurisdiction over questions of forfeiture under the 28th (now 37th) section of the Patent Act;" and Henry J, in rendering judgment in the case, upon referring to Dr. Taché's decision in Barter *vs* Smith, says: "Having well considered the case as presented before him, I would have come to the same conclusion as he did. I think the law as laid down and explained by him, in his exhaustive, and I will add, able judgment, cannot properly be questioned. I fully concur in his conclusions, as I do also in his reasons." Again, by the Superior court at Montreal, as reported in the Mitchell and Hancock Inspirator company case, p. 2, where proceedings had been instituted for infringement of the patent in that court, and the special pleading was met by demurrer to that effect, that the nullity caused by violation of the 28th (now 37th) section of the Patent Act cannot be tried by any other court than that of the Minister of Agriculture, upon which a stay of proceedings was asked for and granted, in order to obtain the decision of this tribunal. Again, in this present case, the Superior court at Montreal has granted a stay of proceedings until the decision of this tribunal shall have been obtained on the question at issue.

I, therefore, hold that the Minister of Agriculture, or his deputy, has exclusive jurisdiction as to the question of the validity of the patent under the 37th section of the Patent Act, and cannot divest himself of it by relegating it to any other tribunal whatever.

Having thus disposed of the preliminary plea, I will now consider the case on its merits. The first consideration which presents itself is to ascertain the nature of the invention claimed by the patent, the claims of which are: First, "An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance made as described, and secured to metallic wires, as set forth; second, the combination of carbon filaments within a receiver made entirely of glass through which the leading wires pass, and from which receiver the air is exhausted for the purpose set forth; third, a coiled carbon filament or strip arranged in such a manner that only a portion of the surface of such carbon conductor shall radiate light as set forth; fourth, the method herein described of securing the platina contact wires to the carbon filament, and carbonizing of the whole in a closed chamber, substantially as set forth."

It is manifestly clear that the essential feature or element of the invention, as particularly described in the [illegible] second claims, is a carbon filament of high resistance; that is the novelty which the inventor has contributed to the art of incandescent lighting, and it cannot be disputed by any one having the slightest acquaintance with patent [illegible] that the carbon filament as imported by the patentee and his representatives, the respondents, and which they [illegible] continue to import, is claimed in and covered by the patent, or that any one who should use it, without the permission or consent of the respondents, would render himself liable to them in an action for infringement of the patent.

The process of further carbonizing the filament [illegible] is introduced into the bulb by passing an electric current through it while a high vacuum is maintained, as described by some of the witnesses for the respondents as [illegible] by Mr. Edison himself, is not anywhere described [illegible] claimed in the patent, and forms no part of it, on the contrary, it is the subject of another patent obtained subsequently by the same inventor, Mr. Edison, on [illegible], under the number 13,057, the fourth and fifth claims of which are as follows: "Fourth. The method of treating carbon conductors for electric lamps, consisting in inclosing the conductor in a glass case or globe, exhausting the air therefrom, heating the conductor by an electric current, and then hermetically sealing the glass case or globe. Fifth. The method of treating carbon conductors for electric lamps, consisting in closing the conductor in a glass globe or exhausting the air therefrom, heating the conductor by an electric current to a higher degree than that at which it is intended to ordinarily raise the conductor in use, and then hermetically sealing the glass case or globe."

Here then the process is fully and explicitly described and claimed, and the use or employment of it cannot be invoked or relied on by the respondents to sustain the patent now in controversy.

The next feature of importance after the method of securing the platina contact wires to the carbon filament, as set forth in the fourth claim of the patent in contestation, is the glass globe or bulb referred to in the third claim, and it is abundantly proved and admitted by the respondents that they have always and still continue to import these, and have never manufactured them in Canada.

Some of the witnesses for the respondents state that the carbon filaments and the glass bulbs are exceedingly difficult to manufacture, requiring great skill and judgment, and that they cannot be made in Canada, and that there is only one factory in the United States where they can be made to the satisfaction of the respondents, but this seems irreconcilable with the statement of these same witnesses in calling these articles raw material. Mr. Edison himself, in his affidavit referring to the glass bulb, says: "They are strictly of the character of raw material" and in view of the fact also that the records at the Patent office show that on November 23, 1882, Mr. Edison obtained a patent for the process of manufacturing glass bulbs for incandescent lamps from pot glass, the allegation of inability to manufacture in Canada is no plea in defence of a Canadian patent, and it would be a singular misconception of the spirit of the law if a patentee probably holding a patent for his invention in the United States or other foreign country, should, suppose he could hold to his Canadian patent, declare his inability to manufacture it in Canada, ignore the fact he was thereby preventing any one else from engaging in the industry, and defeating the very object and intention of the Patent Act, enacted to encourage and protect home labor and manufacture.

The bamboo cane was, and continues to be, imported from Japan into the United States by the respondents in its natural state, and was there, by a series of manipulations or processes, reduced to a filament of required size and proportion, and was then further subjected to the very difficult and delicate process of carbonization, and in this state was imported into Canada expressly for use in the lamps.

The platinum, another compound part of the invention, was, and still is imported into the United States from Russia by the respondents, and was there melted and alloyed with iridium, drawn into wire and otherwise specially prepared, and then imported into Canada for use in the lamps.

I find that every essential feature, element and component part of the invention was, and still continues to be, imported into Canada by the respondents in a manufactured state for the especial purpose of assembling or putting them together so as to make an incandescent electric lamp such as that described and claimed in the patent held by them, and now in dispute.

The two cases of Ayer and Grinnell in the Supreme court, referred to at the argument but not yet reported, do not apply to the present case, as those two suits were brought under the Customs Act, in virtue of which the defendants had a perfect right to import the articles separately and if afterward by compounding or combining these together they manufactured an article or commodity of greater commercial value, subject to a higher tariff duty, they contravened no section of the Customs Act giving them the exclusive right to manufacture, on condition that they should not import, such as that in the Patent Act, which gives the inventor the exclusive right to manufacture his invention, on condition that he shall not import it, there is, therefore, no analogy between those two cases and the one now under consideration.

I therefore hold that the patentee and his representatives have imported into Canada since the 17th day of November 1880, and still continue to import, the various elements and parts comprising the invention claimed in the patent No. 10,654 in a manufactured state; and that they have not at any time since the date thereof manufactured the invention in Canada.

In view of the above I do not consider it necessary to do more than refer to the other point raised in this case that of refusal to sell and even if I had to pronounce upon this

[illegible]

CORRESPONDENCE.

New York Notes.

New York, March 16.—Since the [illegible] [illegible] of New York and the [illegible] appropriating [illegible] cured to purchase and install in the state prisons necessary plants, it was decided [illegible] the state authorities [illegible] elaborate experiments with the death-dealing current. The object of these experiments was to determine the [illegible] points of application, duration of contact, and electromotive force of the current. Current was [illegible] from a Siemens alternating current dynamo, whose fields were separately excited, a rheostat was provided for varying the electromotive force from 100 to 1,000 volts. A Cardew voltmeter, with resistance of similar wire in its circuit, was used to measure the pressure, and a series of incandescent lamps was connected in parallel to check the reading.

Nine experiments were made, with the following results: First. Small white dog, weight 21 pounds, connections from right fore leg to left hind leg, using cotton waste saturated with solution of zinc sulphate, with density of 1.10; held in place by wrapping with bare copper wire, in all experiments the electrodes were saturated with the same solution, resistance 2,700 ohms, contact for 10 seconds under 700 volts' pressure. Second. Large black Newfoundland dog, weight 57½ pounds, connections from brass plate electrode 4½ inches by 6 inches covered with felt [illegible] inches thick, placed on middle of forehead; second electrode on right hind foot same as in previous case; resistance 2,200 ohms; contact for 15 seconds under 300 volts pressure. Third. Mongrel bird dog; weight 60 pounds; plate electrode on back of neck and wire electrode on right hind leg; resistance 2,200 ohms; contact for 10 seconds under 700 volts pressure; resistance after death 250 ohms. 4th. Small dog, weight 35 pounds, plate electrode on forehead and wire electrode on right hind leg; resistance 470 ohms; contact for 10 seconds at 500 volts pressure; resistance after death 488 ohms; increase probably caused by drying out of solution under wire electrode, as it steamed during time of contact. Fifth. Calf weighing 74 pounds; connections from right hind leg to plate electrode on back of neck; hair saturated with solution, but not clipped; resistance 500 ohms; contact for 15 seconds under 300 volts pressure. Sixth. Calf weighing 100½ pounds; connections from plate on forehead to right hind leg, resistance 550 ohms; contact for 20 seconds under 800 volts pressure; resistance after death 280 ohms. Seventh. Calf weighing 95 pounds, connections similar to that of number six, resistance 340 ohms, contact for 15 seconds under 800 volts pressure; resistance after death 230 ohms. Eighth. Calf weighing 109 pounds; connections from right fore leg to left hind leg; resistance 380 ohms; contact for 20 seconds at 800 volts pressure. All of the calves were dressed by butchers, and were pronounced fit for food. Ninth. Horse weighing 830 pounds, connections from plate electrode on forehead to left hind leg; resistance [illegible] ohms; contact under 1,000 volts pressure for 25 seconds; resistance after death 200 ohms. After death the circuit was again closed to ascertain whether the muscles would still respond to the action of current, the muscles were made rigid during continuance of current, and relaxed as soon as circuit was opened. In every case death was instantaneous without a sound or struggle. In each case the muscles of the subject stiffened when circuit was closed, after about five seconds they gradually relaxed. The number of alternations was 288 to 300 per second. The experiments were under charge of Dr. Carlos F. MacDonald and others representing the state assisted by Dr. A. D. Rockwell, Dr. Edward Tatum, A. E. Kennelly and Harold P. Brown.

The lighting of the tunnel of the New York Central railroad underneath Fourth avenue will soon be accomplished. The officers of the company have had in mind some time the solving of the difficulties attached to lighting this tunnel, and have decided upon a plan which will probably be adopted inside of a month. They propose to string electric incandescent lights about thirty feet apart at

about the height of the seats in the coaches. The dark- [illegible] annoyances to people who go back and forth from the suburban towns every day. There is a great passenger traffic over this [illegible] and the proper lighting of the tunnel will assist in [illegible] annoyances and [illegible]

The unsteadiness of the prices of copper is affecting the interests of the wire men materially. There is little con- [illegible] that the stock of the [illegible] prices will soon set- [illegible] manufacturers and con- [illegible]

[illegible] lighting [illegible] is fitting up [illegible] of the Bank of North [illegible] Wall and William streets. [illegible] a view of New York bay, and one can see as far as the Atlantic Highlands. [illegible] in New York than [illegible] ready for occupancy May 1st.

[illegible] challenge has been sent the Westinghouse [illegible] Harold P. Brown and he evidently means to enforce attention. He recently challenged the Westing- [illegible] the Westing- [illegible] paid no attention to the matter. Now Mr. Brown challenges the Westinghouse people to a [illegible] Johns Hopkins university to test the accuracy of their statement that they gave [illegible] per cent. more light per pound of coal than is given by any direct system of lighting. He proposes that there be sent to the Electrical Testing Bureau at the university a plant, comprising dynamos and lamps of the Thomson-Houston system—650 lights, and that the Westinghouse people send a 650 light, alternating current Westinghouse system, and that the test be carried on for three months. They are to ascertain the efficiency of the dynamos and lamps, and the efficiency of converters under full load, half load, and one lamp only on each converter; also to make a life test of the lamps. If the Westinghouse apparatus proves to give 50 per cent. more light, or even 25 per cent. more light, per pound of coal than the Thomson-Houston system, Mr. Brown agrees to pay all expenses of the test of the apparatus, and will purchase Westinghouse apparatus at list price, and will present it to the university. If the Westinghouse apparatus falls below the other in efficiency, he proposes that the Westinghouse company pay all expenses and buy the Thomson-Houston plant at list prices for the university. The Electrical Testing Bureau will publish a full report of the test and the figures secured. If Mr. Westinghouse does not send his apparatus, with the privilege of installing it there by his own men, Mr. Brown says he will feel justified and at liberty to obtain the 650 light Westinghouse plant and have it installed by former Westinghouse employes for the test. T.

Philadelphia, Pa.

PHILADELPHIA, Pa., March 16.—Electrical matters in [illegible] interest. All of the companies are busy, and every manager encountered is full of expectations as bright as the electric lights he is introducing. There is work enough for all, and a very good feeling is manifested. The Edison people are in the lead. [illegible] largest [illegible] in the United States, or what is claimed to be. It has been described heretofore, [illegible] is necessary. It is located on Sansom street, a narrow street running parallel [illegible] Ninth street, within [illegible]

[illegible] an enormous structure, more like a baronial castle of [illegible] front [illegible] from the pavement [illegible] nine stories in height. [illegible] The elevator capacity is [illegible]

absolutely noiseless and sparkless. The company has a large number of these motors running in the western states, New York and through the east, and have for some time past had four of them running in Chester, Pa., giving entire satisfaction. They have recently put in a 3-horse power motor for Jacob Bennett & Son, the manufacturing jewelers of 1024 Chestnut street. This is the first motor they have put in here. It is running well and is giving power to all the lathes and other machinery, as well as a large blower, and is doing all required of it with perfect satisfaction.

C. F. Langston & Co. of 70 North Fourth street, are the sole agents for the Climax engine and dynamo. They recently fitted the Pennsylvania Sugar Refinery of this city with one of these Climax engines of 16 horse power, and a 100 light dynamo. They have also recently put in for Eyster & Son of Halltown, W. Va., three Climax engines and a 75 light dynamo, and are now building another 100 horse power Climax engine for the same firm.

McNulty & Connor of 323 Arch street were about to install an electric light plant at Broad and Columbia avenue, and March 4th started out there to commence operations. On arriving they found the building had been burned down during the night. S.

Indianapolis, Ind.

INDIANAPOLIS, Ind., March 15.—A number of prominent residents of North Illinois street, this city, have been circulating a petition among residents of that street asking the council to order the street car company to put in an overhead electric motor system, and maintain it. It is doubtful if the council will act favorably on the matter, as there seems to be considerable opposition among members to the introduction of electricity as motor power for street cars.

The Indianapolis Jenney Electric company have been awarded the contract for furnishing all the necessary machinery, etc., for lighting the streets of Marietta, O. The Jenney Electric company is furnishing quite a number of incandescent lights to business houses in this city.

The Brush company is also putting in incandescent lights where customers call for them. They have only furnished arc lights heretofore. M.

St. Joseph, Mo.

ST. JOSEPH, Mo., March 16.—The South Park Railway company has elected the following officers: President, J. D. McNeely; vice-president, A. D. Vories; secretary and treasurer, Charles Pfeiffer; directors, J. D. McNeely, A. D. Vories, Charles A. Pfeiffer, Joseph Hansen, John Doniphan, B. B. Frazier, Abner Copeland, Jacob Madinger and James Craig, Jr. The capital stock of the company is $100,000. It will be managed as an independent line.

In all probability the People's Street railway will consider using small iron poles about two inches in diameter, erected in the middle of the street in between the two street car tracks.

The aldermen composing the electric light committee are busy drawing up specifications for the plant, to be submitted to the builders. In view of the rapid manner in which the city is spreading, it is the intention of the board to put in at least a 400 horse power engine, so that additional lamps can be put up any time without increasing the capacity of the power house. The company furnishing the plant will provide the poles, wires, engines and boilers, everything except the building, which will be erected by a local contractor. While it is supposed that 200 lamps will be sufficient to light the city, the matter will first be referred to an expert, who will determine the number of lamps necessary, and their most advantageous location.

One very important consideration in regard to the power house is that it must be absolutely fire-proof. P.

St. Louis, Mo.

ST. LOUIS, Mo., March 16.—In September next the St. Louis exposition will again open its doors. The committee has commenced correspondence with inventors and manufacturers of electrical machinery in America, England, Germany, [illegible] Spain, Belgium and France, and the exhibit [illegible] the latest improvement which have [illegible] The northern nave of [illegible] to the electrical [illegible] of motors, telephones [illegible] dental and surgical [illegible] plating processes, mining and [illegible] the foundation walls [illegible] the center of the [illegible] that [illegible] operated by a [illegible] be three stations and [illegible] the northwest station will be a coal mine lighted by electricity, and operated by electrical drills. The corridors on the east and west sides will be closed, except at the ends, so that the trains will be run through two tunnels lighted by electricity. One of the most ingenious things yet spoken of is an automatic switch which will be placed on the east side. It is a straight track that branches off from the main track, and one car stands on it. When the road is doing an unusually heavy business, and additional accommodations are required, the operator of the train will touch a button as he passes the switch, the extra car will start down the switch, and when it is on the main track it will automatically reverse its motion, then increase its speed until it catches up with and attaches itself to the train. In the nave will be the telautograph. The electrical display will be under the supervision of David J. Harris. Phonographs will be operated for reproducing music, and Gilmore's full band will be the subject of the experiments. A phonograph and receiver will be placed in the large hall, and every strain of music that is played will make its impression on the cylinder of the phonograph. The cylinders will then be taken to other instruments in different parts of the building, and there exact reproductions of the music, just as Gilmore played it, will be given. R.

Kansas City, Mo.

KANSAS CITY, Mo., March 16.—Robert Gillham, M. C. Gillham, E. R. Gill and W. W. Alexander have incorporated the Gill-Alexander Electric Manufacturing company, with a capital stock of $300,000. The company is organized for the purpose of manufacturing electrical apparatus under patents granted W. W. Alexander.

Judge Stover last week rendered an opinion in the case of Dr. E. Jesserich against John Walruff. Last summer a man named Marden, in the employ of the Walruff Brewing company, was injured. A bookkeeper of the company telephoned for Dr. Jesserich. The latter sued the proprietor of the brewing company for medical services. Judge Stover decided that the user of the telephone was not responsible to the physician.

The directors of the Missouri & Kansas Telephone company met last week and discussed the bill now pending in the state legislature, reducing telephone rates to $48 a year, and the opinion prevailed that, if the bill becomes a law, it would be best for the company to cease doing business in this city. No more orders for new telephones will be filled until the bill is acted upon.

A. O. Morgan of Boston was elected a director to take the place of the late George L. Phillips of Chicago. C. D. Crandall, secretary of the company, resigned, and will accept a position with the Western Electric company of Chicago. W. W. Smith, superintendent of the Kansas City exchange, was elected secretary, and N. R. Ferguson was elected treasurer.

"We are making no money in Kansas City," said President Mulvane of Topeka. "When the bill to reduce our rates was introduced in the legislature, we cut our force of sixty linemen in this city down to ten men, and we are renewing no subscriptions and making only conditional new contracts. If the bill passes we will cancel every contract at its expiration, and move every instrument out of the city. We have thirty-four other exchanges and can manage to exist without losing money here. We control 1,900 patents that may be used in this district, and no other company could get them, nor could they use telephones without them."

Residents of the little smelting city of Argentine, Kan., just across the river from Kansas City, Mo., are in an extremely happy mood over the prospect of having an electric light system. The council has granted a franchise for an electric light system to a company headed by Millard V. Ingram of Kansas City, Kan. F.

Louisville, Ky.

LOUISVILLE, Ky., March 15.—At a recent meeting of the council Mayor Jacob presented a recommendation for the establishment of an extensive system of electric lights in the city. He said: "The truth is that what is known as 'progress' has made such strides that no city that aspires to metropolitanism can afford not to have the central and business portions of its domain made light by electric lights. The eye has become so educated by this wonderful invention that it is no longer a luxury, so to speak, and streets that were formerly brilliant are now dim and provincial-looking, because of gas lamps." The mayor proceeded to say that for a year past he had been studying the best plan of supplying Louisville with electric lights. He recommended that Main street, from First to Fourteenth, Market, Jefferson, Green, Walnut, Chestnut and Broadway, from First to Seventh, and all the intermediate cross streets, be lighted by electricity. He also thought that the entire river front should be thus lighted for police protection. The proposition was received very favorably by the council, but was referred for consideration. A.

THE ELECTRIC LIGHT.

Hampton, Ia., wants electric lights.

Upper Sandusky, O., will soon have electric lights.

Hayward, Cal., will soon have an electric light plant.

The Edison plant at Carroll, Iowa, will be in operation soon.

Marshall, Tex., is introducing electricity for street lighting.

Mascoutah, Ill., will introduce electric lights immediately.

Americus, Ga., contemplates lighting its streets by electricity.

Marietta, Ga., will be lighted by electricity in a couple of months.

The electric light plant at Troy, O., is rapidly nearing completion.

Delphos, O., is considering the advisability of introducing electric lights.

Fort Collins, Col., is extending its electric light system throughout the city.

The electric light works at Streator, Ill., have been removed to the new station.

The Macon, Ga., Gas company will light the public buildings by incandescent lamps.

Bids for lighting the state house of Kansas will be solicited by the executive council.

The Nevada legislature has appropriated $1,500 for electric lighting in the capitol building.

Piedmont, W. Va., has organized an electric light company with a capital stock of $20,000.

The Jenney Electric Light company is erecting a line for incandescent lamps at Saginaw, Mich.

The Union Pacific depot at Council Bluffs will be illuminated by eight 2,000-candle power lamps.

The Cincinnati Electric Storage company has been incorporated with a capital stock of $100,000.

A Thomson-Houston company for arc and incandescent lighting has been established at Helena, Montana.

The Madison, Dak., Electric Light, Heat & Power company has been incorporated, capital stock, $25,000.

The Salt Lake City Electric Light company is endeavoring to renew its contract with the city authorities.

Shullsburg, Wis., wants electric lights, and Edward G. Leszynsky has made a proposition to introduce a plant.

Alma, Neb., proposes to utilize its fine water power for electric lighting. A plant will be installed immediately.

The Peoria Ill., Electric company is considering the advisability of introducing incandescent lights in the city.

Another electric light company is anticipated in Louisville, Ky., and it is expected the plant will be installed during the summer.

The Heisler system will be introduced in Ottawa, Ill., and the Morris *News* is agitating the subject of securing similar service for its town.

The Edison Electric Light company of Little Rock, Ark., has been obliged to enlarge its plant owing to the rapid increase in the demand for incandescent lighting.

The Detroit council committee on public lighting will recommend an appropriation of $145,000. Six new towers and twenty-five poles are required on the outskirts.

Marietta, Ga., has closed a contract with the Indianapolis Jenney Electric Light company for twenty-five arc lights of 1,200 candle power each for street lighting.

The Mankato, Minn., Gas & Electric Light company, organized with a capital stock of $100,000, has purchased the gas works and electric light plant, and will run both.

The Grand Rapids Electric Light & Power company has closed a contract for the purchase of a $20,000 incandescent light plant from the Westinghouse Electric company.

The Silvey Electric Light company has closed a contract with the city council of Bowling Green, O., for lighting the city by electricity. Fifty arc lamps and 600 incandescent lights will be installed.

The Edison Electric Light company has closed a contract for an electric light station at Piedmont, W. Va., for a 20 arc light plant and 500 16 candle power incandescent lamps. It will be established within ninety days.

The Western Electric company of Chicago has received an order for 245 arc lamps, 60 double arc lamps, 150 incandescent lights, with dynamos, engines, etc., from Partridge & Co., for their Boston store, Chicago.

Belleville, Ill., Electric Light and Power company, capital stock $25,000, has been incorporated to furnish light and power; incorporators, E. Abend, J. Eimer, A. Karr, S. Mueller, G. Gauss, M. W. Carter and J. A. Day.

Senator Grady introduced a bill in the New York legislature last Saturday providing that any incorporated city or village in that state may dispose at auction of the right to string electric wires and erect poles within the corporation limits.

The Thomson-Houston company of Chicago reports the following recent sales: Chicago Arc Light & Power company, 50 arc lamps; Hastings, Neb., 25 arc light plant, Thomas Electric Light & Power company of Ottawa, Ill., 600 alternating incandescent light plant, Pine Bluff, Ark., Water & Light company, 600 alternating incandescent plant; A. L. Ide & Son, Springfield, Ill., [illegible] plant, Winchester, Ind., [illegible] light plant, [illegible] Ind., [illegible] light plant, Franklin MacVeagh, Chicago, 200 incandescent light plant.

Galveston, Tex., has [illegible] contract to the Western Electric company [illegible] furnish the city an independent plant for $[illegible] in five year instalments, with electric apparatus to the value of $[illegible].

C. C. [illegible] has just completed [illegible] incandescent lamps [illegible] System, for the [illegible] company at Gould, Montana, and [illegible] for the Livingston [illegible] Helena Smelting [illegible] company of East Helena, Montana.

The Houghton, Mich., Peninsular Electric Light [illegible] company, at a recent meeting of the directors [illegible] establish a central station plant at Red Jacket, Mich., and authorized its general manager, James R. [illegible] ate for the machinery and other necessary apparatus.

The South End Electric Light company, at Chicago—capital stock, $30,000—has been organized for the purchase, sale, renting and furnishing of electric and other lights, lighting apparatus, power and machinery. Incorporators G. Falkenberg, F. D. Foster, [illegible] and Frank Reidle.

Officers and directors of the Bloomington Electric Light company have been elected as follows: President, R. W. Murphy; vice-president, Lyman M. Graham; secretary and treasurer, C. Rayburn; superintendent, J. H. Miller; directors, Calvin Rayburn, J. H. Miller, Lyman M. Graham, R. W. Murphy of Bloomington, W. J. Buckley of Chicago, R. T. McDonald and C. L. Olds of Fort Wayne, Ind.

Among the recent sales of the Queen City Electric company, Cincinnati, the following are reported: Henderson, Ky., Home [illegible] Mills, 50-light dynamo, W. E. Oglesby Paper company, Middleton, O., 75-light machine; James Nottenman & Co., Cincinnati, O., one 4 horse power motor; Binzle & Co., Cincinnati, O., one 4 horse power motor; Jos. R. Peebles Sons, Cincinnati O., one 3 horse power motor; Razell & Co., Cincinnati O., one 7 horse power motor.

Work on the addition to the electric light station at Omaha is progressing rapidly, and it is thought that in two weeks more the incandescent plant can be started. The building is inclosed, the work of setting the boilers is nearly completed, and the principal work remaining to be done is to get the engines and dynamos in position. The outside work, that of wiring the streets and houses for the new system, is well advanced, and will be completed before the plant is in readiness for operation.

A. L. Ide & Son have received a ten-year contract for lighting the streets of Springfield, Ill., with arc lights of 2,000 candle power, at $137 per year for each light. In connection with this contract they have agreed to furnish incandescent lights for commercial use at a price not to exceed the cost of gas of equal illuminating power at $1.50 per 1,000 feet; also to furnish current for electric motors from 1/8 to 10 horse power within 2,000 feet of their station at a cost not to exceed $100 per year for each horse power for ten hours' use per day. They will erect a new station of sufficient size to enable them to operate by electricity the street railway, of which Mr. Ide is president.

The city council of Milwaukee is considering the question of electric lighting. The committee on street lights will recommend that the consideration of the amendment to the Badger ordinance granting exclusive privileges for conducting an electric light plant for twenty-five years, be indefinitely postponed. The resolution ordering the removal of a cable which was laid by the Western Electric company of Chicago, will be rejected, so that there is no obstacle in the way of consummating the plans for establishing another electric light plant in accordance with the charter of the Milwaukee Telegraph company, which already has applied for permission to lay a conduit on East Water street. The conduit will be used by the Western Electric company, which, backed by local capitalists, is expected to begin operations at an early day.

THE ELECTRIC MOTOR.

Cincinnati will soon have another electric road.

Fort Worth, Tex., boasts of an electric railway.

Pittsburgh capitalists have subscribed $25,000 for the building of an electric road in that city.

The Port Huron, Mich., Electric Railway company will improve its service greatly during the summer.

H. O. Woodruff reports the sale of a 3 horse power Hawkeye motor to L. J. Wells of Des Moines, Ia.

The Kester Electric company of Terre Haute, Ind., has been incorporated with a capital stock of $100,000.

The Watervliet Turnpike company of Albany is considering a proposition to substitute electricity for horse power on its street railway.

The Salt Lake City Street Car company has purchased a site for an electric power plant, and will introduce the electric system at once.

The Brooklyn City Railroad company is experimenting with electricity, and it is probable the storage battery system devised by Prof. William Main of Brooklyn will be adopted.

The Seattle Electric railway has begun an action for damages against the cable road of that place. The trouble is over the crossing of the roads at the corner of Pike and Second streets. The electric company complains that the cable company tore up the track of the electric company during the night and did not use due diligence in placing the frogs, thus delaying traffic on the street railway un[illegible]

[illegible] terest.

[illegible]

The [illegible] Votey Organ company of Detroit [illegible] order [illegible] for the largest reed organ ever built in this country. It is to be a three manual pedal bass, operated by an electrical blowing apparatus, [illegible] successful operation [illegible] Detroit, Pittsburg, Philadelphia and Wilmington. These instruments have recently been introduced in Japan, and several electrical organs are now being made for Yokohama.

Senator John Raines of Canandaigua has introduced into the New York legislature a bill empowering the Niagara Falls Hydraulic company to erect and maintain under the falls machinery for generating electricity, and to use such state lands as necessary for erecting poles or constructing an underground conduit to carry its wires. As the bill does not provide for the payment to the state for the franchise or secure the free lighting of the state reservation at Niagara Falls, it is expected it will meet with considerable opposition.

THE TELEPHONE.

Wheeling, W. Va., and Waynesburg, Pa., will soon be connected by telephone.

Preparations are making for the opening of a telephone exchange in Albany, Ga.

President Payne of the Milwaukee Telephone company says that corporation will expend $[illegible] in burying its wires.

Telephone connection between Augusta and Atlanta, Ga., was secured last week, a distance of 171 miles. A telegraph wire was used.

A number of telephones were burned out in Cleveland recently through carelessness on the part of a lineman, who allowed a line to drop across an electric light wire.

The Western Electric company of Chicago has just closed a contract with the Colorado Telephone company for 4½ miles of underground cable, to be used at Denver.

The Central Telephone company has completed its line in Pennsylvania, and Greensburg has telephone communication with Pittsburgh, Scottdale, Brownsville, Uniontown and other places.

A practical experiment was lately made on a French railway line to show that communication by means of the telephone may be made from a disabled train to the neighboring stations. On the line from Noyelles to Saint-Valery, where a telephone wire runs along the line, a train stopped in open country. With the aid of a portable telephone connected to the wire, communication was then made with the two stations, one ahead and the other in the rear of the train.

THE TELEGRAPH.

The Milwaukee Telegraph company has been granted permission to construct a conduit for experimental purposes.

The question as to whether telegraph companies are obliged to show duplicates of messages transmitted over their lines when so ordered by court or other similarly organized body has again been raised in the investigation at Albany before an assembly committee.

Telegraphic communication with the United States has been established by cable from Santiago de Cuba to Hayti and San Domingo, thence to the Island of Curaçoa, thence to La Guayra and Caracas, Venezuela, where connection is made with the government land lines to points in the interior.

A dispatch from Santa Fe says: The Supreme court has affirmed the decision of the lower court giving damages of $[illegible] against the Western Union Telegraph company to Dr. R. H. Longwill for carelessness and negligence in the delivery of a telegram in an important [illegible]. The case has been in court five years.

A dispatch from Baltimore, Md., says: [illegible] South Atlantic Telegraph company of Baltimore city has been incorporated with a capital stock of $[illegible]. It is said that the new company is to form a link in the Mackay-Bennett Postal Telegraph Cable company's system, and is for the purpose of purchasing and owning the [illegible] systems in Maryland, which are now [illegible]. [illegible] amalgamation with the Southern [illegible]

graph company of Virginia, the Southern Telegraph company of North Carolina, and the Southern Atlantic Tele- [illegible] may be secured ex- [illegible] the entire south and southwest. This entire system is to be controlled by the [illegible]

A dispatch from Waterloo, Ia., says: "The Postal Tele [illegible] men at work in this section setting telegraph poles along the Chicago, St. Paul & [illegible] They claim the Postal com [illegible] new copper telegraph wires from Chicago to St. Joseph, Mo., along the line of the Stickney road."

Personal Paragraphs.

H. F. Walters, of the New Haven Clock company, New York, was in Chicago last week.

E. R. Stevens, manager of the Splitdorf Insulated Wire company of New York, was in Chicago last week.

James P. McQuaide of the National Conduit Manufacturing company of New York, was in Chicago last week.

Frank Warren, secretary and treasurer of the Omaha, Neb., Illuminating company, was in Chicago last week.

Daniel B. Russell, vice-president of the Parker-Russell company of St. Louis, was in Chicago last week. Mr. Russell has just returned from a trip to California.

C. D. Crandall has resigned his position as secretary and treasurer of the Missouri & Kansas Telephone company to accept a position with the Western Electric company of Chicago.

H. C. Davis having resigned in February as president of the New York Electric club on account of prolonged absence in Europe, the managers have filled the vacancy by electing E. T. Gilliland president for the unexpired term.

C. D. Haskins, who has been for years identified with electrical work, especially in telegraphy, is in Chicago. Mr. Haskins, who is connected with the Western Electric company's office in New York, will remain in Chicago two months.

Business Mention.

Woodworth & Smith, 99 West Fourth street, Cincinnati, have been appointed general agents for the motor department of the Queen City Electric company of Cincinnati.

The work on the Sprague road at Chattanooga, Tenn., is progressing rapidly under the supervision of Woodbridge & Turner, 17 Cedar street, New York, the contractors.

An extremely interesting exhibition of the Porter Electric Messenger was given at the office of the New Haven Clock company in Chicago last week. The call system, as operated by this Porter Messenger, is efficient, and it is attracting the attention of hotel managers in all parts of the country.

The Reliance Oil & Grease company of Cleveland, O., are reporting a large increase in sales, and have received from all branches of the manufacturing trade liberal encouragement of late. The goods of special high grade produced by them are in demand. This company will give prompt attention to all correspondence, and will send samples free with catalogue, etc.

The ordinance prepared by Corporation counsel Green, [illegible] the National Transit company the privilege of laying pipes for oil across the Lake Shore & Michigan Southern railway in Chicago, provides that in case of transfer the ordinance shall be null and void. This dis- [illegible] statement that the Standard Oil company would secure the franchise immediately from the National Transit company. The introduction of this oil in Chicago will be of interest to electric light men, who are desirous of [illegible]

The Standard Electrical works, Cincinnati, representa- [illegible] company, report the demand for [illegible] increase. They have [illegible] with the Cincinnati Railway [illegible] wire for the main [illegible] the best aerial wire [illegible] Cincinnati, has [illegible] The Standard Electri- [illegible] and have [illegible] the best good.

Electrical Patents.

[illegible]

399,291. Hydraulic Press for Covering Electrical Conductors with Soft Metal. Werner Siemens, Berlin, Germany.

Claims 2 and 15 follow

"2. In a hydraulic press for covering electrical conductors with soft metal, the combination of a plunger rotated in a plane perpendicular to the direction of the mandrel, with a mandrel capable of being raised and lowered.

"15. The combination of the six-edged guide-piece, and the mandrel constructed in two sections, one of which screws into the other."

399,292. Electrical Measuring and Controlling Apparatus. Wilhelm Siemens, Berlin, Germany.

The statement of invention is as follows: The invention relates to apparatus made use of for the observation and measurement of physical magnitudes of every description—for instance, the measurement of the potential difference between any two points of an electrical circuit, the height of water-level, etc.,—and the object thereof is to render such measurement easy and reliable without resorting to the use of sensitive measuring instruments, which might require skilled attendants and frequent adjustments. This object is attained in case of the measurement of length by the conversion of that measurement into one of the potential difference of two points in an electrical circuit; and the invention relates to apparatus used for such conversion, and for the measurement of the potential difference which may be caused thereby.

Of the fourteen claims the second is given: "In an electric meter, the combination of a measuring and regulating circuit, an electromotor, the field and armature coils thereof forming a part of the measuring circuit, means included in the regulating circuit for controlling the movements of the armature of the motor, and resistances adapted to be included in or excluded from the regulating circuit varying the current thereof while the current in the measuring circuit remains unaffected thereby."

399,305. Lightning Arrester. Charles H. Wilson, Columbus, O.

The invention consists of two springs placed over metal plates the springs being connected by a fusible wire, which wire rests upon a bead provided upon the frame or base.

399,314. Telegraph System. William Burnley, North East, Pa.

The last claim is given:

"4. The combination of the cup containing a conductive fluid, the reservoir or feed-cup communicating therewith, and the plunger with the armature lever, the metallic electrode having a non-conductive tip, and the electro magnet co operating with the armature lever."

399,320. Dynamo Machine. George L. Du Laney, New York, N. Y.

399,326. Coupling for Electric Circuits. Albert C. Griggs, Wilmington, Del.

399,328. Dynamo Armature. Joel A. Hayes, San Francisco, Cal.

The last claim reads.

"8. In a dynamo-electric machine or motor, an armature coil whose core consists of a set of separated iron plates connecting non magnetic plates, and projecting through them to form polar extensions."

399,329. Commutator for Dynamo-Electric Machines and Electric Motors. Benjamin Heywood, New York, N. Y.

399,331. Electric Railway Switch and Alarm. William S. Hull, Sheffield, Ala., and James C. Anderson, Charleston, S. C.

The fifth claim is:

"In combination with a railway switch, circuit-making and breaking devices arranged in circuit with an electric magnet, a signal plate carrying a pivoted armature, and an audible alarm connected with said armature, and with a contact point therein, and a spring for completing the circuit of the audible signal when the armature is otherwise uninfluenced."

399,336. Electric Meter. Edward F. H. H. Lauckert, Charlton, County of Kent, England.

399,341. Electrical Appliance for Stopping and Starting Elevators. Ronald F. McFeely and Henry V. Potter, Pittsburgh, Pa.

399,343. Underground Electric Wire Conduit. William L. Penney and Thomas Little, Pittsburgh, Pa.

399,372. Electric Railway System. Charles S. Bradley, Yonkers, N. Y.

The last claim follows:

"10. In a plant for the generation and utilization of electrical energy, the combination of a prime mover, a dynamo-electric generator, and an electric motor energized thereby, both said dynamo electric generator and motor having each a dynamic capacity in excess of that of the prime mover, whereby the maximum effort of the prime mover may be exerted either in tractive force or speed on the part of the electric motor."

[illegible] Separator. [illegible] Burden, Troy [illegible]

[illegible] John [illegible], New York [illegible]

[illegible] telephone system and [illegible] lines, the lines com- [illegible] at interval and [illegible]

[illegible] Protector. [illegible] Harvey [illegible]

399,401. Prevention of Sparking in Dynamo-Electric Machines and Electric Motors. Daniel Higham, Philadelphia, Pa.

A bar of iron is used to conduct magnetic lines from the field magnet to the short-circuited armature coils, and so arranged that the intensity of the magnetic field passing through the bar may be varied.

399,402. Prevention of Sparking in Electric Generators and Motors. Daniel Higham, Philadelphia, Pa.

The first claim reads: "A dynamo-electric machine or electric motor having a magnetic conducting bar acting upon the short-circuited armature coils a helix upon the said bar, and coils upon the field magnet connected to the said helix, but not connected with the field magnet coils or working circuit."

399,403. Dynamo Electric Machine. Daniel Higham, Philadelphia, Pa.

The dynamo electric machine or electric motor is provided with a horizontal field magnet coil which rests upon and is secured to the pole pieces between which the armature revolves.

399,404. Dynamo Electric Machine. Daniel Higham, Philadelphia. Pa.

The first claim is given: "A commutator having segments and intermediate insulating blocks with air spaces or slits extending down into the intermediate insulating blocks, and clamping rings not covering the ends of the slits."

399,409. Conductor for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

The working conductor consists of a tube having a longitudinal slot and also having the thickness of its metal greater as the slot is approached from either side.

399,416. Electric Gas Lighter. Edward Kronenberg, Philadelphia, Pa.

399,474. Railroad Signaling Device. Frank P. Benjamin, New York, N. Y.

399,497. Combined Gas and Electric Light Fixtures. John C. Cassidy, East Orange, N. J.

399,505. Transmitting Instrument for Electric Signaling Apparatus. Walter J. Dudley, Everett, Mass.

399,507. Switch for Electric Motors. Arthur H. Eddy, Hartford, Conn.

Claim 3 reads: "In an electric motor having a switch for changing the machine into a shunt or series machine, the combination of the switch, with a catch for holding it in its position for starting, and a spring for throwing it into its second position upon releasing the catch."

399,534. System of Electrical Distribution and Conversion. Thomas H. Hicks, Detroit, Mich.

399,535. Secondary Battery. Joseph L. Huber, Hamburg, Germany.

399,550. Electric Switch. Harry T. Paiste, West Chester, Pa.

399,556. Electric Railway Signal. Theodore A. B. Putnam, N. Y.

The principal feature of the invention consists in the application of an induction coil at a signal-transmitting point arranged to receive a current through its primary wire upon the passage of the train, and with its secondary wire connected through the medium of an intervening circuit or conductor with a distant signaling point, and an electro magnet or equivalent signal-receiving instrument at such distant point adapted to be acted upon by the secondary currents generated in the induction coil

399,579. Semaphore Signal. Frederick Stitzel and Charles Weinedel, Louisville, Ky.

Claim 3 is given: "The combination with a railroad track, of two semaphores having electro magnets, a closed circuit through the railroad tracks and semaphore located at one end of a block, a second closed circuit through the track, a conducting wire and a semaphore at the opposite end of the block, and contact pieces attached to the first-mentioned semaphore to normally close said second circuit."

399,591. Coin-Operated Induction Coil. Percy G. Williams and Alfred W. Roovers, Brooklyn, N. Y.

The tenth claim reads: "The combination, with a movable electrode, of a weight connected to said electrode, an arm connected to said weight, a rod having a sliding connection with said arm, an abutment for said rod, a receptacle for coin, and an opening and closing device operated by said rod."

399,599. Regulator for Electrical Machinery. George H. Condict, Philadelphia, Pa.

Claim 20 is given: "In a regulator, the combination of a rotary barrel switch for varying the flow of current in the line, a small pinion on said switch, a segmental rack of great radius meshing with said pinion, and a hand lever for operating said rack pivoted on an axis at right angles to the barrel of the switch."

399,635. Telephone Line Cable. George F. Shaver, New York, N. Y.

399,639. System of Electrical Distribution. George Westinghouse, jr., Pittsburg, Pa.

The invention relates especially to the system of electric distribution in which alternating electric currents are transmitted over main conductors to points near the stations at which they are to be utilized, at which stations electric converters are employed for transforming the currents.

The last claim reads: "7. The combination, with the primary circuit of an electric converter, of multiple mains and circuit controlling devices for connecting any pair of said mains to said primary circuit."

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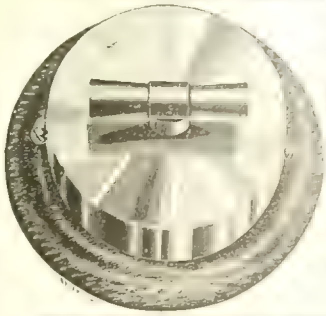

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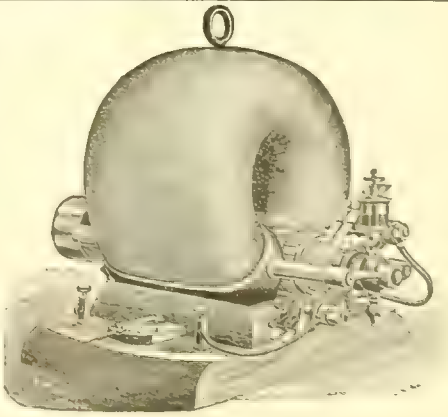

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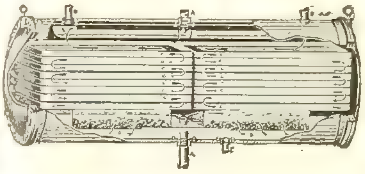

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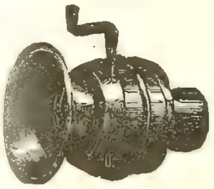

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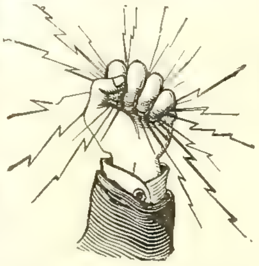

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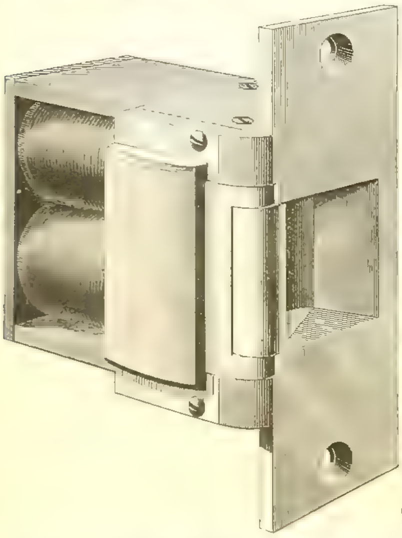

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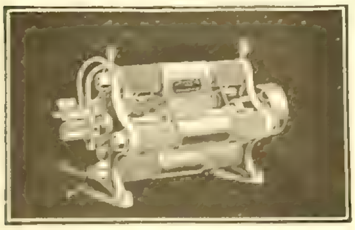

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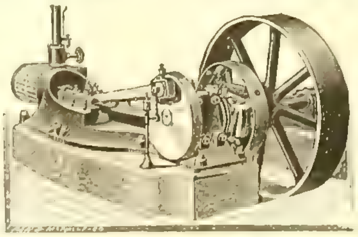

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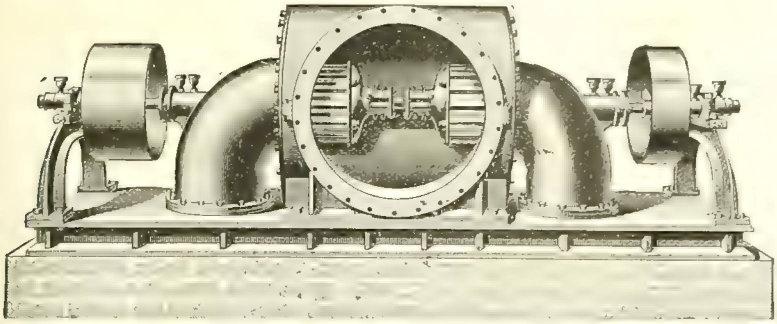

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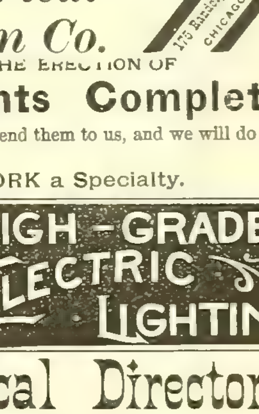

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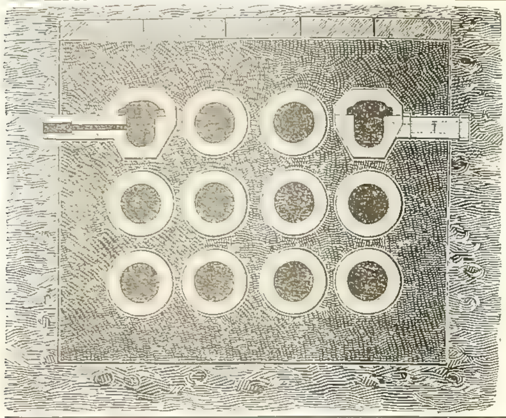

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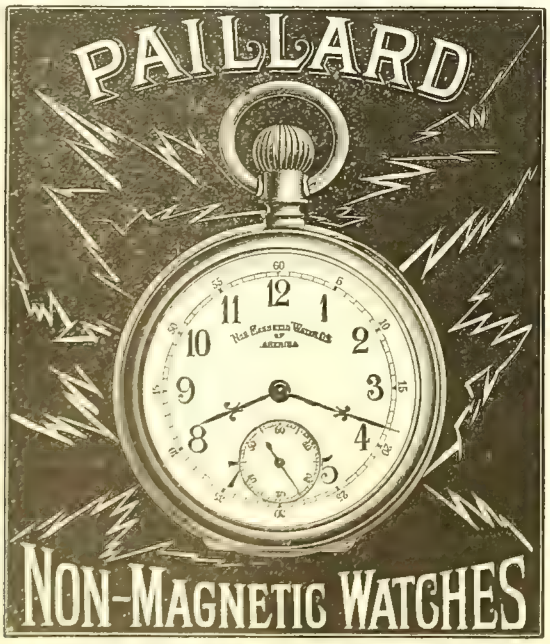

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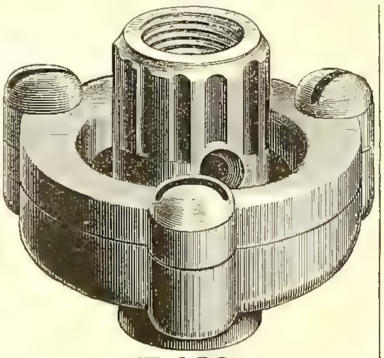

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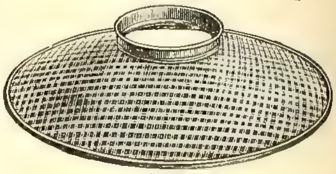

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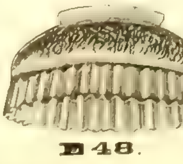

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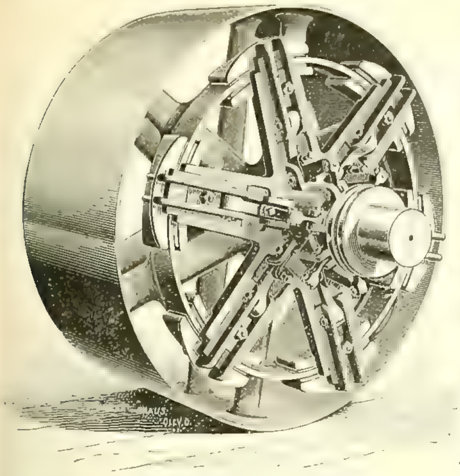

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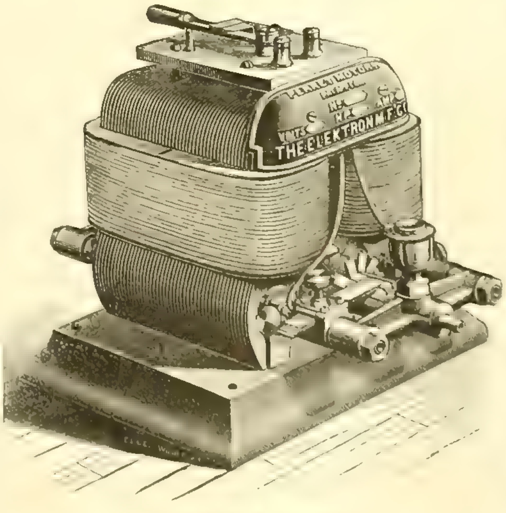

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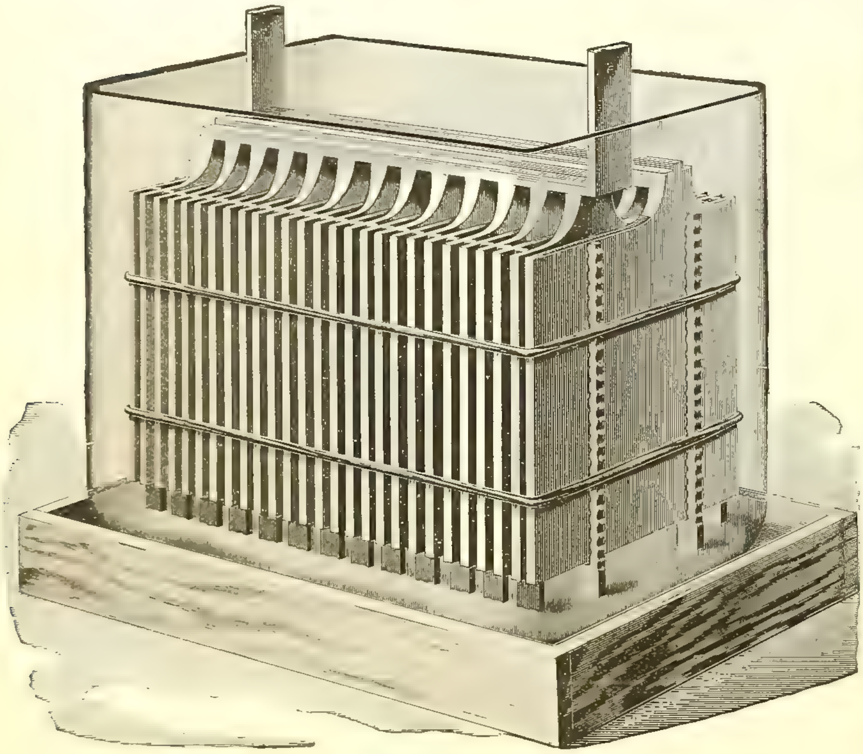

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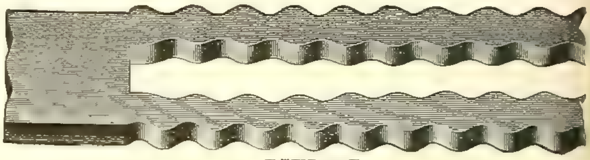

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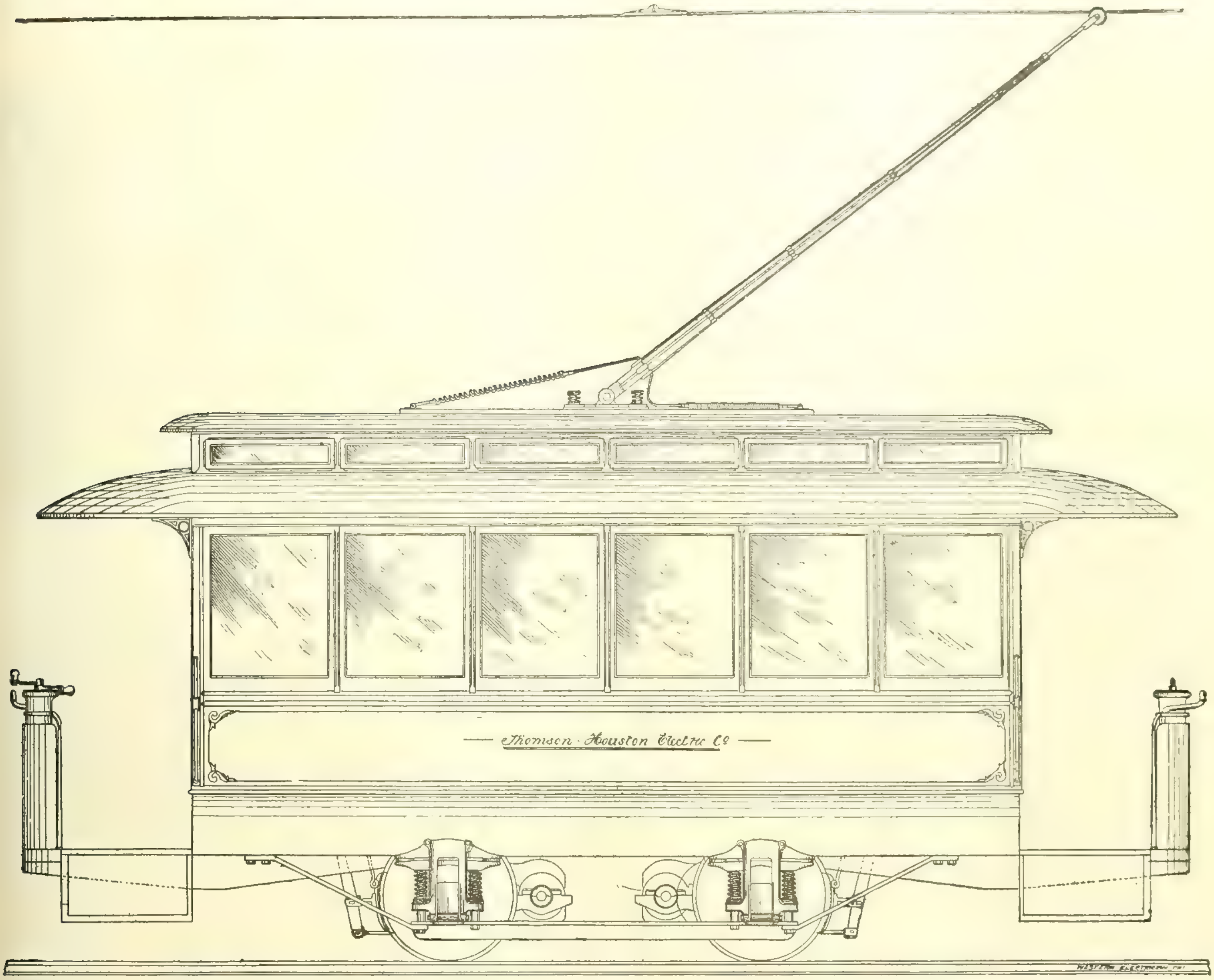

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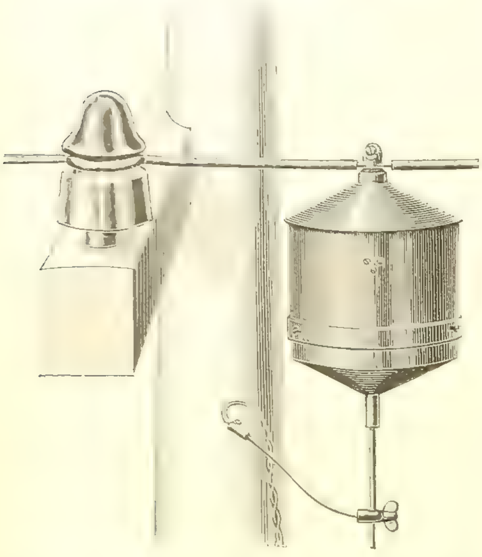

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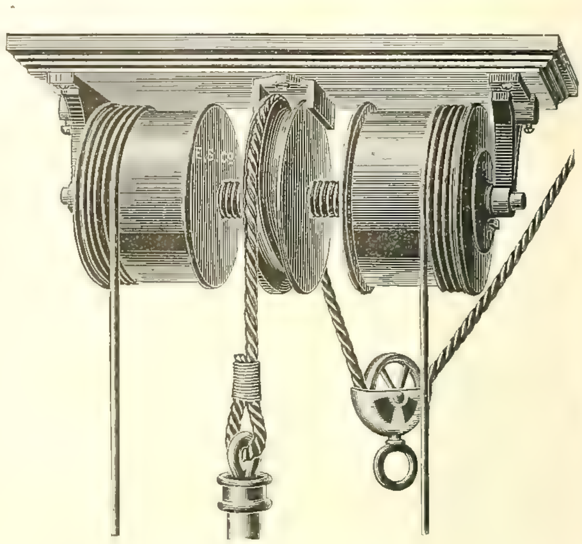

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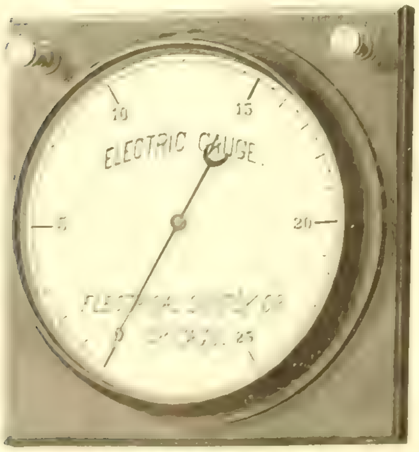

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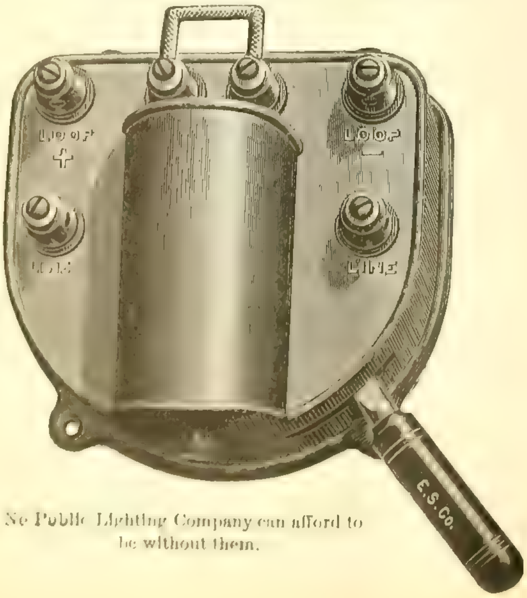

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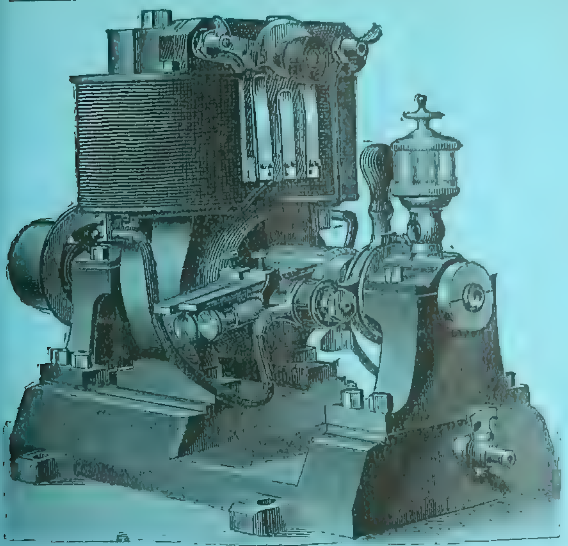

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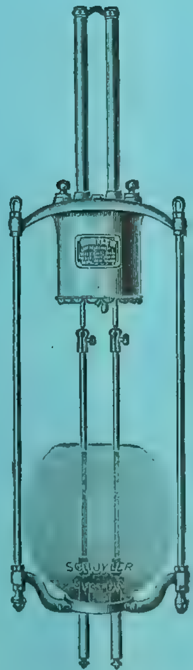

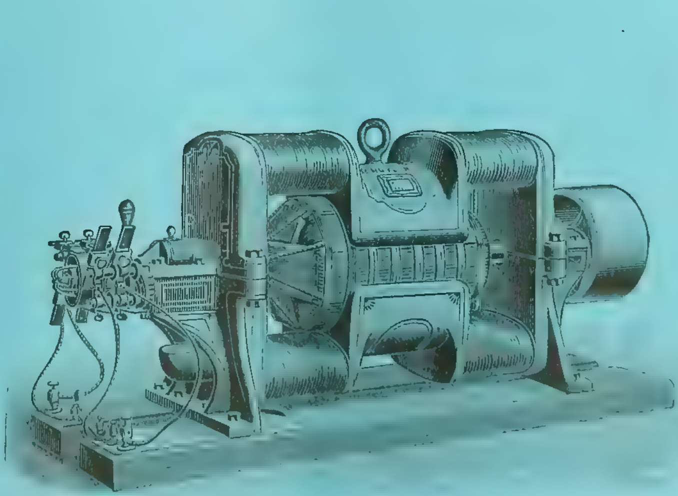

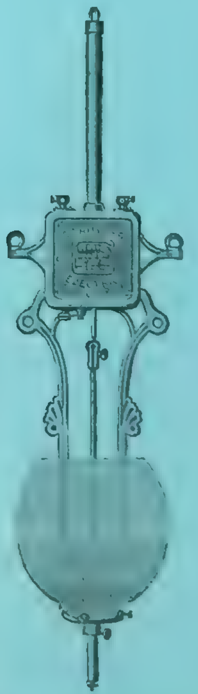

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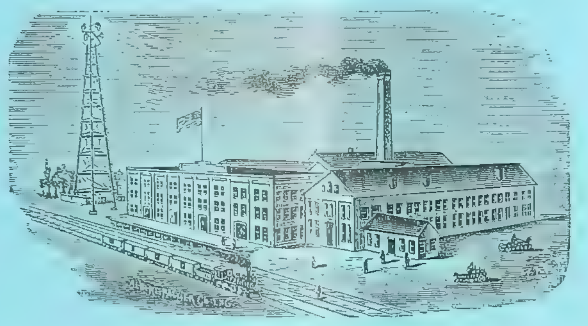

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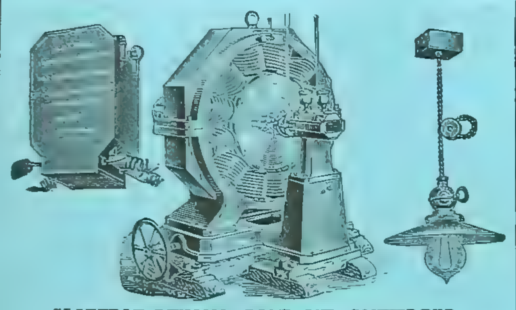

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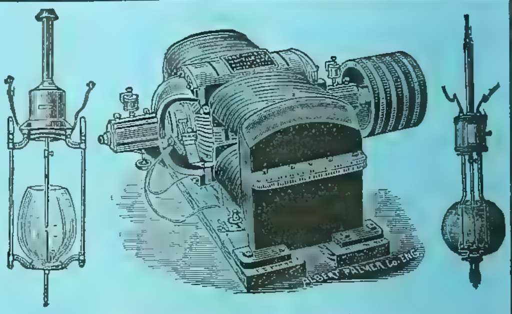

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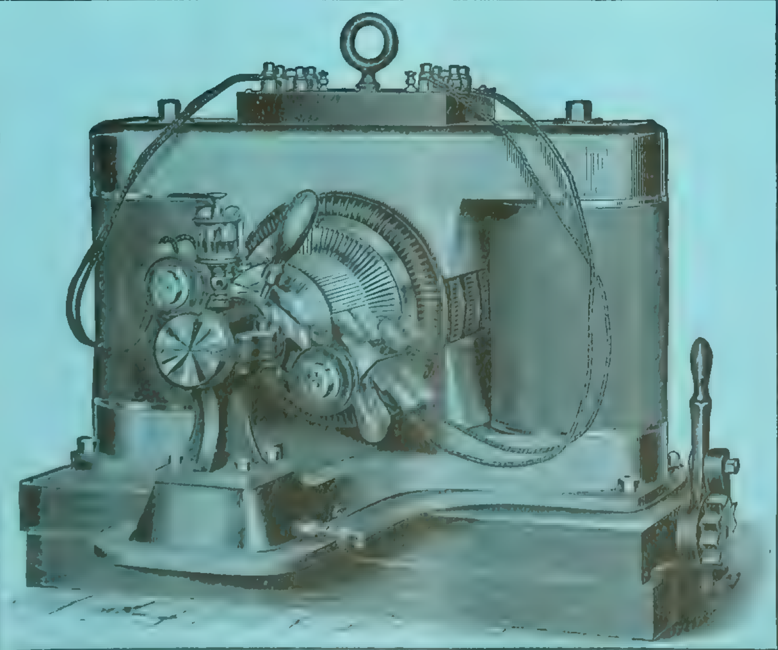

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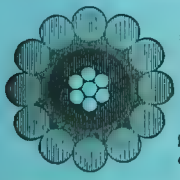

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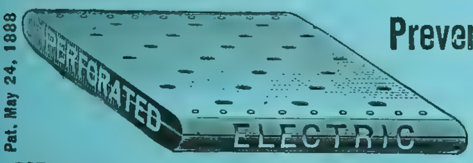

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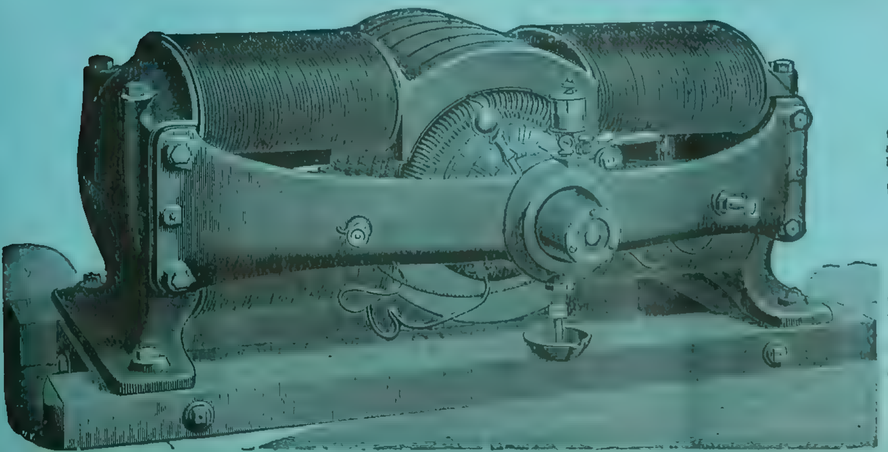

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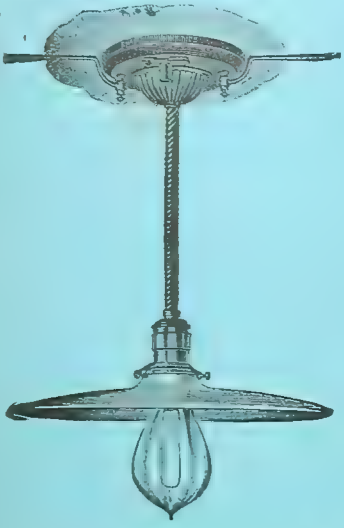

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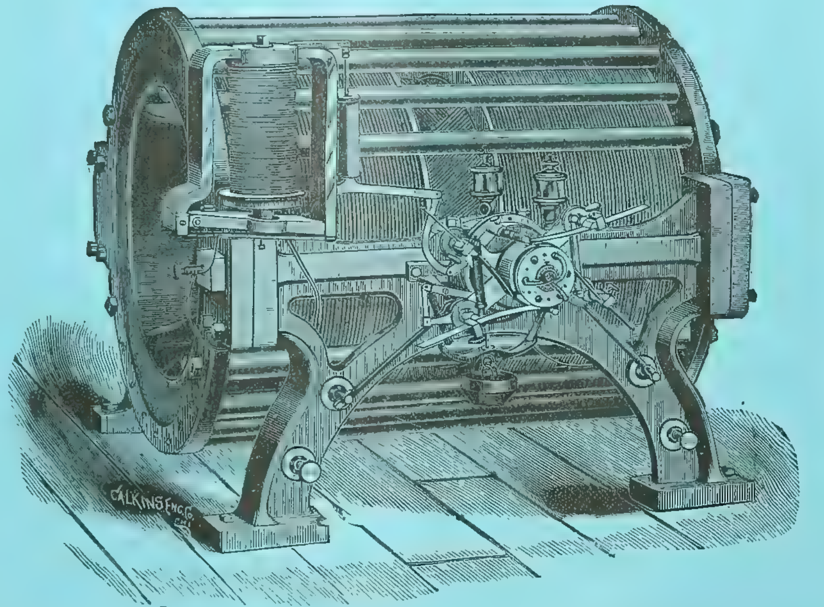

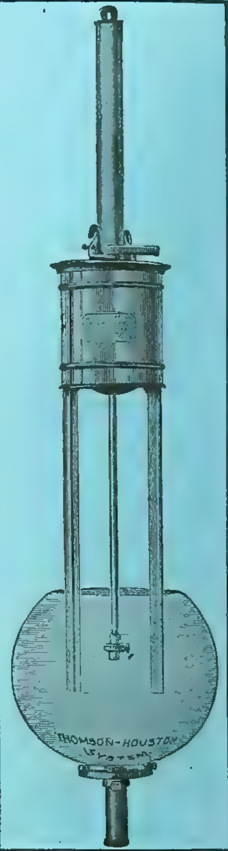

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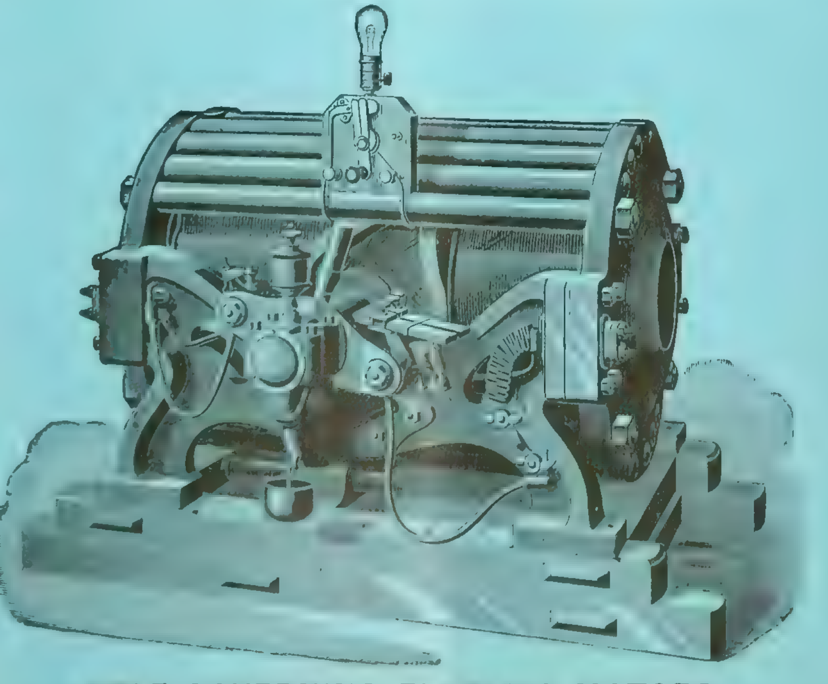

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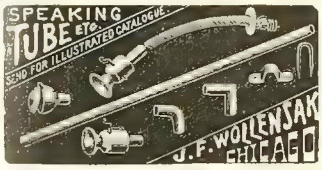

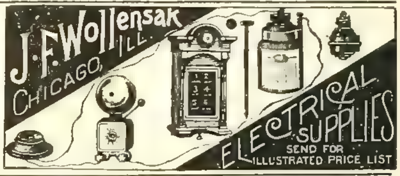

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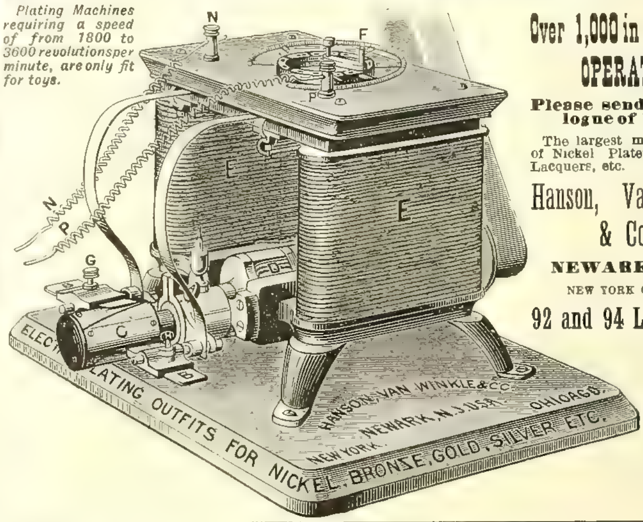

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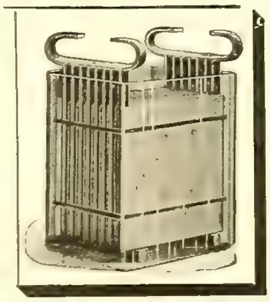

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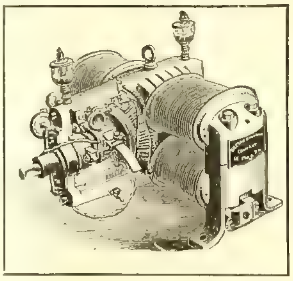

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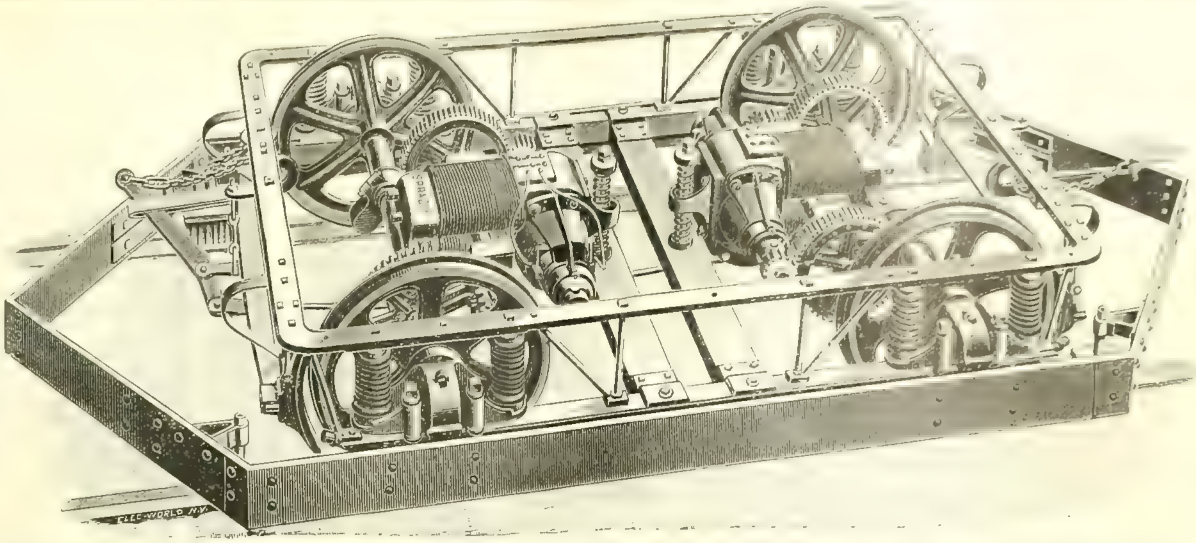

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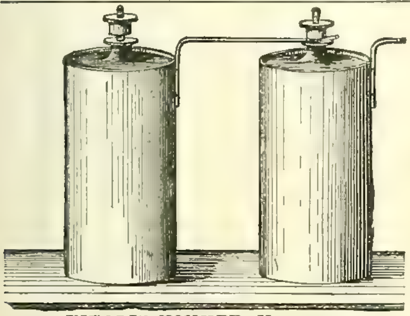

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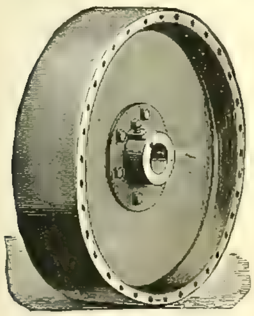

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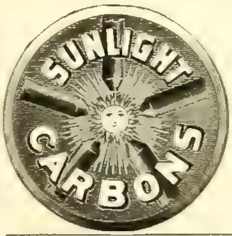

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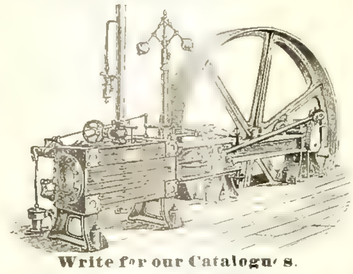
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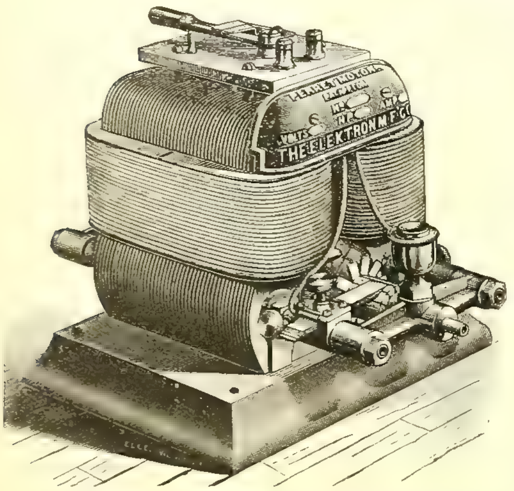

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Takes pleasure in announcing to its patrons and the general public that the decision of the Supreme Court of the United States, filed on the 21st ult., in the case of the Bate Refrigerator Company, is in fact a decision

SUSTAINING THE EDISON PATENTS

In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor ?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

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EVERY SATURDAY.

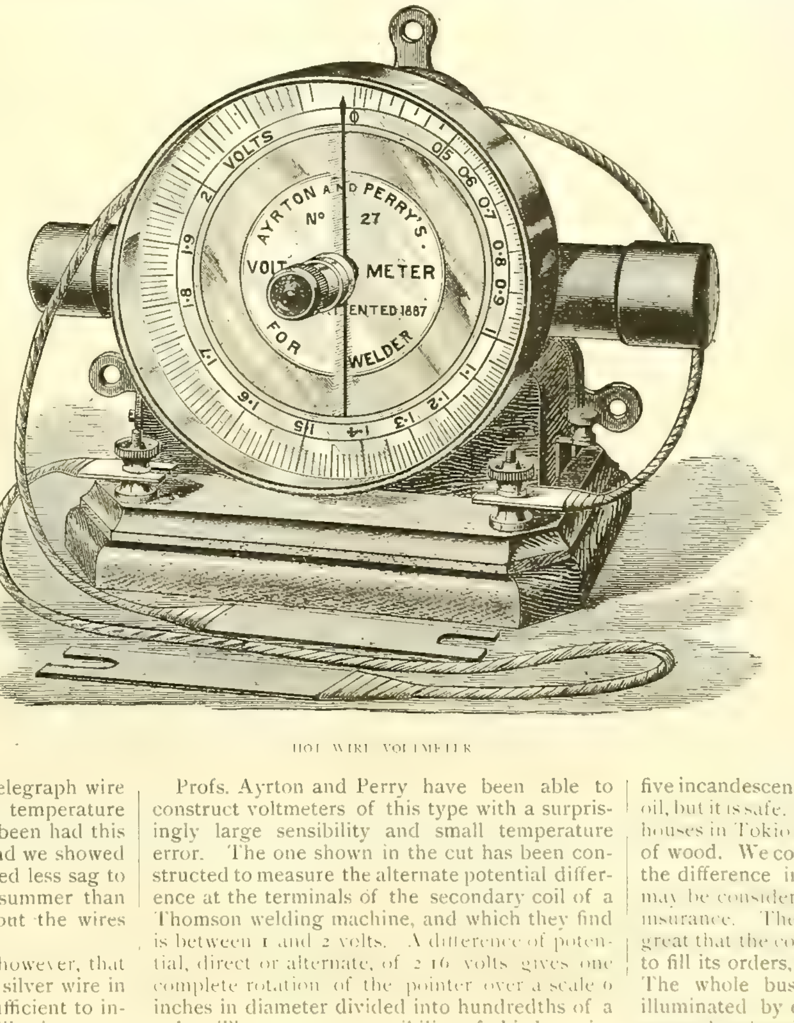
Vol. IV. CHICAGO, MARCH 30, 1889. No. 13

Ayrton & Perry Hot Wire Voltmeter

Profs. Ayrton and Perry's hot wire voltmeter, which was exhibited at a recent meeting of the London Physical society, is shown in the accompanying engraving. The instrument has excited no little interest, on account of its accuracy and its novel construction. In exhibiting the instrument Profs. Ayrton and Perry stated, in a paper which they had prepared on electrical measurement, that at the end of 1877 they brought before the Society of Telegraph Engineers a modification of the well-known Cardew voltmeter, which could be used to measure either a direct or an alternate difference of potential. Their modification was a very simple one; instead of measuring the actual extension of a straight wire, as Captain Cardew had done, they measured the change of sag of the wire by using a magnifying spring. The sensibility of the arrangement was very great, indeed.

The paper continued: At the time our hot wire voltmeter was first shown we described what we believed to be the mathematical theory of its working. In our original paper, in which we gave the formula connecting the deflection of the instrument with the volts required to produce the deflection, we gave a calibration curve, determined theoretically, connecting the deflection with the volts required to produce the deflection. But we neglected the variation in the length of the fine platinum wire due to the alteration of stress as the sag altered—*i. e.*, we assumed that the wire expanded simply because it was heated, and we did not take into account the fact that when it expands and gets longer the stress is altered, and therefore the length of the wire is altered. This omission is the more curious since one of us had pointed out some months previous to that, that while the cooling of the telegraph wire in the winter diminished the length, and therefore the dip, the increase of stress caused an expansion, so that the whole change of sag in a telegraph wire which occurred with a change of temperature was not as much as it would have been had this change of stress not taken place, and we showed that this compensating effect enabled less sag to be used on telegraph wires in the summer than would be otherwise possible without the wires being broken in the winter.

We were under the impression, however, that the actual stress in the platinum silver wire in our hot wire voltmeters was not sufficient to introduce a change in their sensibility in consequence of the alteration of stress that occurs with alteration of sag. Experience, however, has since shown that that is not the case, and that when the wire gets hot and expands and the dip increases, the diminution of stress actually allows, as it were, a contraction of the wire, or, in other words, it does not expand as much as it would were there not this compensating action. This compensating action, which is very valuable to the telegraph engineer, has the very opposite character for the constructors of our voltmeters, because it tends to diminish their sensibility. Each hot wire voltmeter should be so constructed that the zero does not alter when the temperature of the whole instrument is changed between the day and the night, or between the winter or the summer; also that a given difference of potential produces the same deflection of the pointer, whatever the temperature of the instrument as a whole. The tube therefore has to be composed of two metals, but the curious thing comes out that the coefficient of expansion of the tube, to get perfect temperature compensation, depends on the initial sag. That is rather an advantage, because it enables us to adjust for zero temperature error. We use iron and copper in the tube in such proportions that the temperature error of the voltmeter is very small, but by a very small adjustment of the sag we can get a temperature error practically nought.



HOT WIRE VOLTMETER

Profs. Ayrton and Perry have been able to construct voltmeters of this type with a surprisingly large sensibility and small temperature error. The one shown in the cut has been constructed to measure the alternate potential difference at the terminals of the secondary coil of a Thomson welding machine, and which they find is between 1 and 2 volts. A difference of potential, direct or alternate, of 2.16 volts gives one complete rotation of the pointer over a scale 6 inches in diameter divided into hundredths of a volt. The extreme sensibility of this hot wire voltmeter was shown at the meeting of the Physical society by using it to measure the e. m. f. of an accumulator, and the fall of the difference of potential at its terminals when the accumulator was sending a current. The e. m. f. of the accumulator used was shown by the hot wire voltmeter to be 2.07 volts, and the difference of potential fell to 2.03 volts when the current sent, as measured by one of their ordinary spring ammeters, was 10 amperes. Hence the resistance of the accumulator was .004 ohm, a result obtained almost instantaneously. The instrument is put on the market in America by James W. Queen & Co. of Philadelphia.

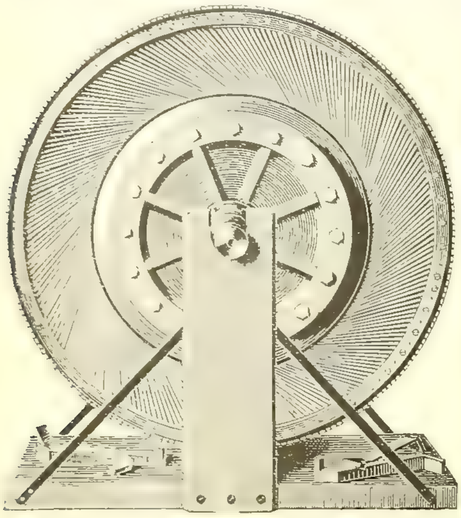
Electricity in Japan

An interesting party of tourists was entertained at the Grand Pacific hotel, Chicago, last week. The party included Prince and Princess Takehito of Japan, Marquis and Marchioness Maida, Liutenant Kozo Yoshie of the Japanese navy, Secretary Momotaro Saito, master of ceremonies of the emperor's palace, and numerous attendants. They formed an interesting group. Lieutenant Yoshie had been in this country before, and not only speaks English fluently, but is thoroughly posted on American customs. A representative of the WESTERN ELECTRICIAN called on the party, and learned that the subject of the development of electricity was occupying considerable attention in Japan. Prince Takehito is traveling incog., thus dispensing with state formalities. He is at the head of the Japanese navy, and the object of the trip is to inspect the navy departments of this country and France. When questioned as to whether they had succeeded in discovering any trace of a navy in this country, Lieutenant Yoshie, who acts as spokesman for the party, smiled and explained the matter to his companions, who laughed heartily. They all seemed greatly pleased with their trip, and evidently were favorably impressed with the country, especially with its extent. Lieutenant Yoshie said he crossed Japan in one day just before leaving. He appeared to take considerable interest in electrical matters, in which all Japanese, he said, were interested. In reference to the present condition of electrical matters in the land of the Mikado, he said:

"On January 11th our emperor's new palace was lighted by 3,000 incandescent lamps, and the grounds about the palace are lighted by the arc lights. It is brilliant, and we are proud of it. My house in Tokio has five incandescent lamps. It costs much more than oil, but it is safe. My house is very old; most of the houses in Tokio are old, and they are constructed of wood. We consider the electric light safe, and the difference in the cost of oil and electricity may be considered as the expense for a sort of insurance. The demand for electric lights is so great that the company furnishing them is unable to fill its orders, though it works night and day. The whole business portion of the town is illuminated by electricity. We do not light our streets by electricity, though. The Edison and Thomson-Houston systems are in use in Japan. Local companies are organized. Before the introduction of electric lights oil was used. Then a gas company was organized in Tokio, but it has not been able to get a foothold. At Osaka a Thomson-Houston company has been organized, and is giving satisfaction. Electric lighting has been introduced into the navy, and our war ships are now lighted by electric lights. We also have electric search lights, and at present we are experimenting on the application of electricity to torpedoes. The Charleston's p[illegible]

an improvement on that in one of our men-of-war, which was designed after an English boat. You will see that the Charleston ought, therefore, to have a [illegible]. We improved the English system [illegible] improved [illegible]. We have introduced electric lights on our mail and passenger steamers [illegible] steamships of the [illegible] Kwa[illegible] been lighted by electricity. This line was established by the Japanese, and [illegible] operated exclusively by them."

In reference to other lines of electrical development, Lieutenant Yoshie said: "The telephone and telegraph are operated throughout the em-



[illegible]

pire. We do not have big exchanges like these in American cities, however. The telephone is operated on an economical plan in connection with the telegraph. The railroad companies use the telephone for communication between stations much more than the telegraph. Both are operated [illegible] the same line. We are experimenting with the long distance telephone, and have succeeded in operating a line nearly 100 miles long. That worked very nicely. The Japanese are very studious people, and they are great experimenters. We have an electrical society there, but I am not familiar with the details of the organization, though I know that such a society exists, and has a big membership. They debate electrical subjects, and make experiments and examine new devices and inventions. There are many scientific societies in Japan. One of these has been making extensive researches on the [illegible] earthquakes, and has succeeded in learning a good deal about their causes. A short time ago they succeeded in causing a slight [illegible] the shock was perceptible [illegible].

[illegible] said that electrical [illegible] to Japan be[illegible] too narrow to [illegible] operated. In Tokio, [illegible] of street cars, and this is more of a nuisance than a benefit. [illegible]

St. Joseph, Mo., Electric Light Plant.

[illegible]

[illegible] low tension, $49,725; Westinghouse Electric company, high tension, $55,315; Thomson-Houston Electric company, high tension, [illegible]. The contract has not yet been awarded.

Wheel Armature Dynamo.

In the WESTERN ELECTRICIAN of February 9th appeared a description of a wheel armature dynamo recently patented by N. Fritsche of Berlin. An illustration of the novel generator was presented at the same time. One of the interesting features of the dynamo is the armature, of which a cut is given herewith. The armature shown in the illustration is that of a 16-pole dynamo, and it consists of obliquely mounted prismatic rods, which are symmetrically arranged in groups of two. Every rod terminates on the periphery of the armature drum in the commutator segments. All these iron rods form one continuous conductor closed in itself; a few of these iron rods are shown in the cut underneath the armature. These rods are connected in two parallel groups, so that only two points of commutation are necessary, which incline to each other at an angle of $\frac{360}{16} = 22.5$

The cut of the armature shows clearly that the different iron rods pass successively all poles, and the total electromotive force at the brushes is the sum of all the electromotive forces generated in the different rods. This way of connecting the armature differs entirely from all other armatures of multiple dynamos. In other dynamos the armature coils are connected in multiple according to the number of poles. Such dynamos are really not multipolar, as they may be considered as two, three or more dynamos connected in parallel.

The advantages of this new dynamo can be seen at once. A great electromotive force may be [illegible] comparatively small speed; [illegible] the armature is better utilized [illegible] of an armature [illegible] amperes per [illegible] much greater [illegible] heating to a higher [illegible] no disturbing [illegible] the iron rods [illegible] all possible [illegible]

[illegible] that it will have a [illegible]

Sprague Electric Railway at St. Joseph, Mo.

One of the most successful electric street railways in the country has been that in operation upon the Wyatt Park company's line at St. Joseph, Mo., a view of which is given in the accompanying cut. The first electric line to be operated in St. Joseph was the Union Passenger railway, also equipped by the Sprague Electric Railway & Motor company, and the success of this line has been so great that the railway company ordered an additional number of cars.

This line at St. Joseph was the first one in the country to practically demonstrate the successful operation of an electric railway in a snowstorm. In the early part of this winter a blizzard from the western prairies struck St. Joseph and covered the streets with snow, to the depth of from six inches to one foot. The telephone, telegraph and electric light wires were borne down by the snow in all parts of the city, and trade was for the time being, according to one of the local papers, almost completely paralyzed. In spite of this general blockade in all directions the electric railway ran uninterruptedly, and the cars plowed their way through the heavy drifts on the line without trouble or stoppage, and without any aid from snow plows.

The road has been very largely patronized by the residents of St. Joseph, and property along the line has greatly increased in value. The grades on the Wyatt Park railway are in some points on the road as high as 9 per cent., and the cars without difficulty reach a speed of fifteen to eighteen miles an hour in the outside and suburban districts, reducing to a lower rate of speed when operating within the city.

St. Joseph, Mo., is coming to the front rapidly as one of the leading cities in electrical enterprise in the west. It already has two street railways operating by electricity on the Sprague system, and a great many manufacturing industries are kept in operation by the same power by means of stationary electric motors operated from the regular railway circuit. It is said that the two other street railways in St. Joseph will soon be in operation upon the electric system.

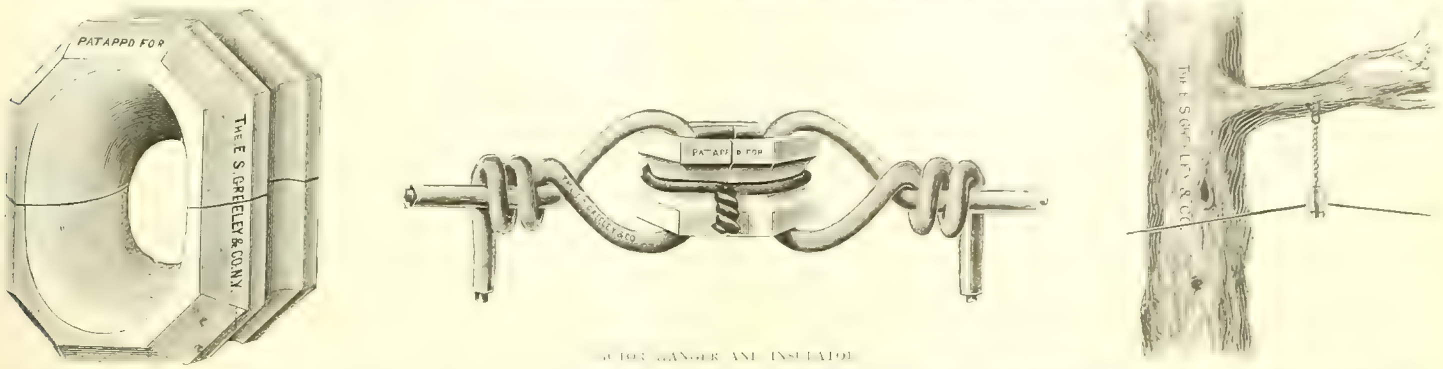
[illegible]

Victor Insulator and Hanger.

The cuts which are herewith presented illustrate applications of the Victor split insulator and the Victor hanger. The insulator is provided with an opening to accommodate the largest wire; it has perfectly smooth bearing and locking lugs, which torsion of the two parts

may be bound together. The insulators being made in two parts they can be put upon a line already erected equally as well as upon a new one; and for taking up sag, and for "guys" and "hauling-off" purposes, they are extremely convenient. They may be used to increase the capacity of cross-arms by suspending them beneath. On elevated road structures and in tunnel work they are particularly useful.

The Victor insulator hanger is made in two sizes, 2 inches and 6 inches respectively. It consists of number 14 galvanized wire twisted together, except at the ends which surround



VICTOR HANGER AND INSULATOR.

the insulator. The ends are long enough to encircle the insulator twice when they are simply twisted together. The hanger is ordinarily made of number 14 galvanized steel wire. The upper end or bearing of the hanger is provided with a stout, smooth thimble that will withstand any abrasion, and which when hung on a hook, staple, or loop of wire, secures a practically universal joint admitting of free motion in all directions. The measurement of the hanger is taken from the center of the eye, or thimble, to the crotch where the wires divide to receive the insulator.

The insulator and hanger are put on the market by The E. S. Greeley & Co., New York.

Chicago Electric Club.

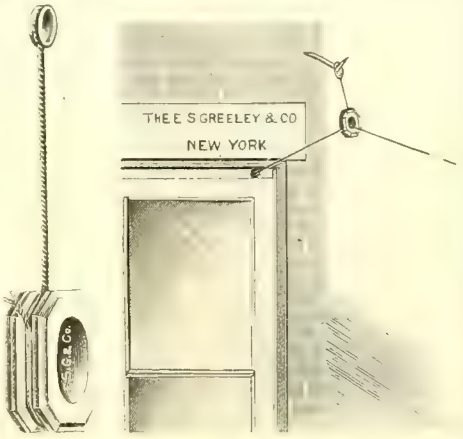
The regular meeting of the Chicago Electric club was held March 18th. The president, S. A. Barton, was in the chair. In calling the club to order President Barton said he had noticed on examining the visitors' book that representatives of eleven states were present at the meeting. It was the duty of the club to extend its hospitality to the members of the electrical fraternity who were constantly coming to Chicago from the east and the west. The club rooms should be of such a character that it would be a pleasure for strangers to visit them. The fact that so many visitors were present indicated that the club could have a large honorary membership. He thought the club should be the largest in the country, and he did not think it would be impossible to secure such a membership. The club should be made an institution of which the members would be proud, and the result could be accomplished if there was a united effort in this direction.

George Cutter read his paper on "Practical Suggestions about Handling Electric Light Circuits," which was published in the WESTERN ELECTRICIAN last week. A short discussion followed:

MR. HASKINS: I want to call attention to the fact that our earth is a monstrous magnet of itself. It has one pole that we call the north pole and one that we call the south pole; half way between the two is the equator. Now we at Chicago are between the equator and the north pole. The north pole is the point of attraction, and the lines of attraction extend from the pole to every point on the circumference of the earth. And we being here at Chicago, the line of attraction to us from the north pole would be a direct line to the north pole. You will see that a direct line from here to the north pole is not a horizontal line. Every magnetic needle that you ever saw is balanced by either putting a little coil of wire around it, or by trimming off a portion in order to make it lie horizontally wherever it may be used. The dip of the needle is an inclination of the north end of the needle point in a direct line. Mr. Cutter has shown us that his magnetism is not obstructed in its passage from the coil to the needle by such interpositions as he was able to place there. Now there are a great many thousand miles of solid earth between here and the north pole that do not affect the magnetism that controls our needle here.

F. W. HORNE: Some few weeks ago I was quite interested in an article by one of our able professors in regard to low and high tension current and I am [illegible] not present this evening to say something [illegible] I think that this is a good time to have [illegible] would like to [illegible] Mr. Cutter the various [illegible] there are between the carbons of the [illegible] arcs, if he can give them off hand, and the [illegible] there is in six ten miles of line wire of number [illegible] I believe, about 25 ohms. In the quantity of current [illegible] the volume of current I presume is about [illegible] amperes. I would like to know what the [illegible] is for each. I put the questions all at once. I [illegible] know the amount of loss in ten miles of circuit [illegible] 6 wire of the ordinary quantity current [illegible] is it 10 amperes of light in number 6 wire of [illegible]

MR. CUTTER: I presume the inquiry is [illegible] my allusion to the difference between the long and the short arc. The short arc of which he speaks has 18 amperes and from 30 to 35 volts generally. The long arc of 10 amperes is generally adjusted to 45 volts. The resistance per mile of number 6 wire is about 2.08 ohms. Ten miles of number 6 wire has 20.8 ohms resistance. The current in the long arc system is 10 amperes. There are for a long



VICTOR HANGER AND INSULATOR.

arc 45 volts. There are 18 amperes for the short arc and 30 volts, from 28 to 33, but, according to my experience, about 30 volts. Now, 10 amperes multiplied by 10, multiplied by 20.8, equal 2,080 watts—10-mile circuit, long arc—10 multiplied by 45 equals 450 watts per lamp; 2,080 divided by 450 gives 4.6 lamps; 18x18x20.8 equals 6,739.2 watts in a 10-mile current with a short arc. 18x30 equals 540 watts per lamp. 6,739.2 divided by 540 equals 12 lamps; 18x26 equals 468; 6,739.2 divided by 468 equals 14 lamps. Ten amperes of electricity passing through 20.8 ohms consumes the energy of 2,080 watts in 10 miles. 10x45 gives 450 watts per lamp; 2,080 divided by 450 gives 4.6 lamps loss in that circuit. Therefore if you are operating a 50-light dynamo with lamps stretched along the distance of a 10 mile circuit you should allow 4.6 lamps for the loss of current or you should operate about 45 lamps on that circuit. Eighteen amperes passing through 20.8 ohms resistance gives 6,739 watts. 18x30, the first assumption for the short arc, gives 540 watts per lamp, which would show a loss of 12 lamps in that circuit. It

[illegible]

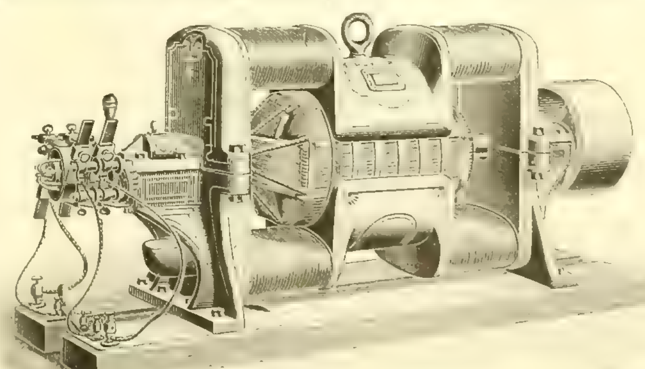
touch where you want to use [illegible] for that reason that you can see it at a greater distance than you can the long arc. I also called attention very casually to another reason for it. That is, this reddish tinge. A red light will show much farther than a blue light. The long arc sends the bulk of its candle power at an angle of 45 degrees—just where you want it because your long arc is placed for illuminating purposes quite a distance above your head, and extends the light down where you want it. I also said that this fact, coupled with its quality of burning quietly, renders it superior to the short arc under ordinary circumstances. That is rather a broad statement, but for the reason just stated it is better for public illumination and private illumination.

A MEMBER: What is it that causes the hissing of the short arc?

MR. CUTTER: I will try to answer it, but it is a matter largely of opinion. It is generally considered to be lack of combustion of the carbon, sending out little fine particles across the arc, and some of them exploding in passing. A combination of the two is considered to be the cause of that hissing. A short arc will hiss. The moment they get down to a certain length as compared with their amperes, they will hiss.

Schuyler Arc Light System.

The accompanying engravings illustrate the improved arc lighting apparatus of the Schuyler Electric company of Middletown, Conn. This company was for many years located in Hartford, but in the fall of 1887 moved to Middletown. The corporation has added largely to its working force, and equipped the factory with all the latest appliances for turning out work. The main factory is four stories in height, and, with the adjoining buildings owned by the com

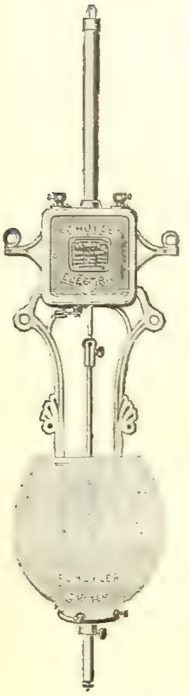


THE [illegible] SCHUYLER [illegible]

pany, [illegible] surface. The company contemplates [illegible] extensive additions to their manufacturing facilities in the near future.

The arc [illegible] [illegible] type, [illegible] for [illegible] for [illegible] with [illegible] the winding [illegible] that a portion [illegible]

ventilated armature is shown in Fig. 4. Since its adoption, some two years ago, there has not been a single case of burn out, and but two accidents from mechanical defects.



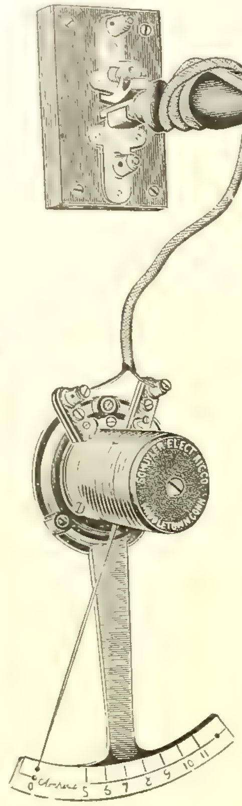


Fig. 2. Fig. 3.

Schuyler Arc Light System.

The automatic regulator, Fig. 6, is instantaneous in action, and so sensitive as to provide for cutting in or out 99 per cent. of the whole load of the dynamo without heating whatever, in the armature or fields. The self-oiling boxes of this system constitute a feature which commends itself highly to electric light men, as they require no attention, except putting in a little oil, say once a month, while the expense of this is hardly worth mentioning. A letter lately received from the lighting company at Westfield, Mass., using the Schuyler system, states that the expenditure for oil on three dynamos, running constantly, has been less than $4.50 for one year.

The single carbon lamp shown in Fig. 2 is of the rack form. The expense for repairs for these lamps during a series of years has been so slight as to excite the most favorable comment from electrical experts. Each lamp is equipped with an automatic cut-out, by which, in case of accident to any single lamp, it is at once thrown out of circuit.

The ammeter, Fig. 3, is simple and reliable. The lightning arresters, Fig. 5, have done such good work as to keep the record of the Schuyler stations entirely free from burning out of dynamos by lightning, though they have been struck many times.

The Schuyler company has located stations at [illegible] fifty towns, principal among which are: Holyoke, Mass.; Westfield, Mass.; Middletown, New Britain, Norwalk, Stamford and Danbury, Conn.; Massillon, Canton, Wooster, Marion, Millersburg and Mount Vernon, Ohio; Wichita, Kan., and many other thriving towns.

Babcock & Wilcox Boilers.

[illegible]

Electric Locomotive on the Birmingham Tramway.

The accompanying illustrations show the general arrangement of the electric locomotive on the Birmingham Eng. tramway. Fig. 1 gives an end view, and Fig. 2 a side view. The locomotive is of the self-contained type, says *Industries*, power being supplied by 100 storage cells, arranged in two longitudinal rows, as shown in the illustration, and leaving a central gangway free for the driver. In this gangway are placed the brake handle and the reversing lever, the latter being also used to regulate the power and speed by a suitable alteration in the method of coupling up the cells. The 100 cells are subdivided into four groups of twenty-five each, which can be used either four in parallels, or two series to parallel, or three in series, or all the four in series. The total weight of the cells in working condition is $4\frac{1}{2}$ tons. The motor weighs one ton, and is series wound. The ordinary brushes are in this machine replaced by metal blocks attached to a series of springs, and held against the commutator in a fixed position, there being practically no lead required with the type of armature employed. The motion is reversed by reversing the direction of current through the armature. Owing to the heavy work which the motor has to do, it was decided not [illegible] reduction of speed, [illegible] gear, and, on account [illegible] spur wheels were [illegible] wheels leads, [illegible] In order to secure ease [illegible] some side play in the [illegible] gear this can be [illegible] the teeth simply [illegible] With helical [illegible] play would be inadmissible if the wheels were keyed fast to their respective shafts, and in order to overcome this difficulty the pinions on the intermediate shafts are mounted on feathers, so as to allow of their displacement in the direction of the axis, in conformity with the side play of the spur wheels on the main axles. The motor is hung from underneath the floor of the car, and to its spindle is keyed a helical pinion geared on both sides with helical wheels on the two first motion shafts. This arrangement has the advantage that the bending stresses on the overhanging part of the motor spindle are balanced, and power is transmitted to both driving axles simultaneously, thus securing a maxmium amount of adhesion. In some trials which were made to determine the tractive force of this locomotive, it was coupled, by means of a spring balance, to one of the ordinary steam locomotives of the Birmingham Tramway company, and set to haul the latter. The brakes on the steam locomotive were then gradually tightened until it was brought to a rest, when the spring balance indicated a pull of $1\frac{1}{2}$ tons, the current through the motor at the time being 200 amperes. This tractive force is greatly in excess of that needed even on the steepest part of the line, which occurs in Bradford street, where the grade is one in seventeen. Previous trials on the tractive power of steam locomotives have shown that the maximum pull occurring in Bradford street when going up hill, and hauling a car of forty passengers, was about 18 cwt., so that the electric locomotive has practically a margin of over 50 per cent. of tractive power above that actually required for coping with the ordinary traffic.

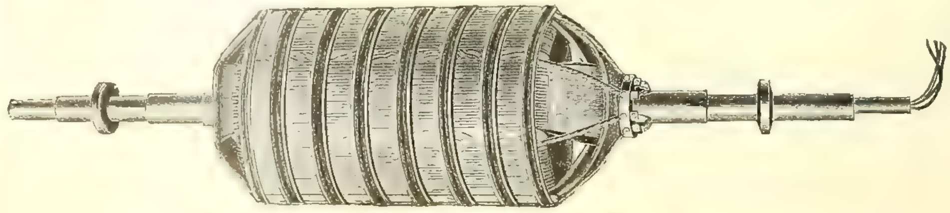


Fig. 4.—Schuyler Arc Light System.

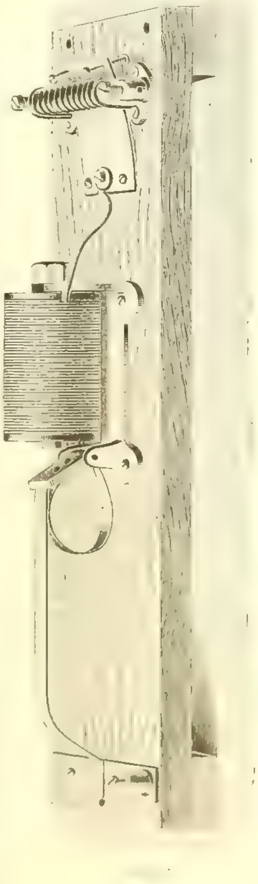


Fig. 5.

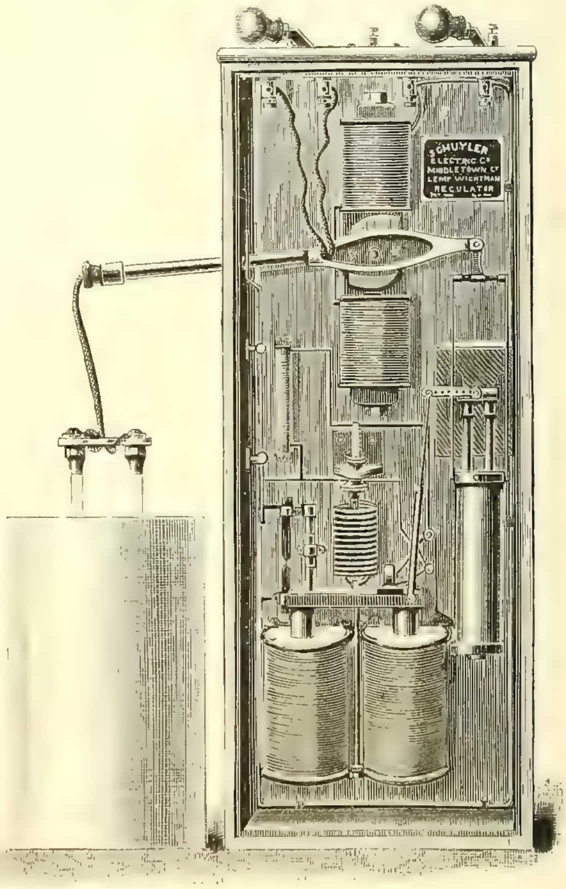


Fig. 6.

Schuyler Arc Light System.

The New York Central Railroad company promises to light the old Fourth avenue tunnel on the Harlem road by electricity.

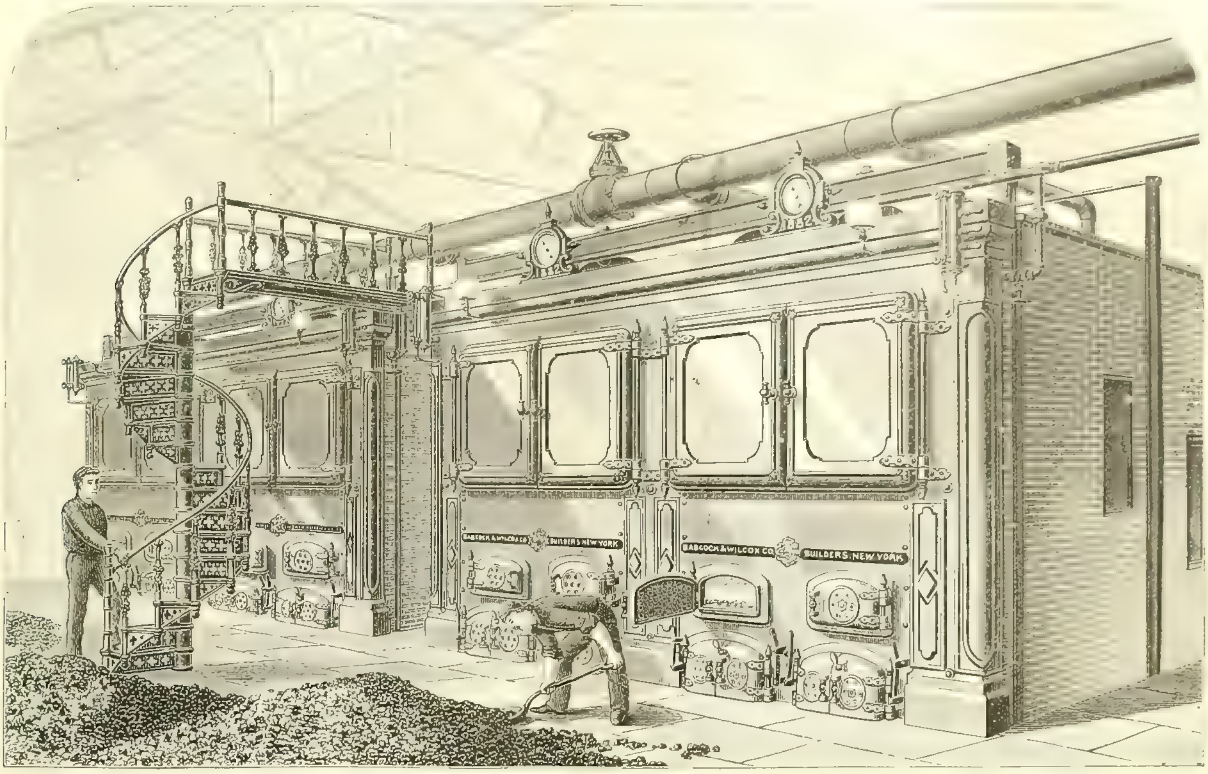
New York Board of Electrical Control.

The Board of Electrical Control met at the mayor's office on the 19th. The engineer of the board reported that the subways begun last year should be completed

ern Union was directed to remove one of its two lines in Hudson street.

Several applications were presented for permits for construction or the making of overhead connections, but the mayor promptly and decisively refused to consider [illegible]

[illegible] in Lexington avenue from Sixty-fifth street to Seventy-ninth street. [illegible]



BABCOCK & WILCOX BOILERS.

without delay, and recommended the building of subways on Sixth avenue from Ninth to Eighteenth streets, in Fourteenth street, and also on the east side of the city from Thirty-ninth to Seventy-ninth streets. These suggestions were adopted. The Metropolitan Telephone company was directed to remove one line of poles on Water street, where it has two lines. The Western Union company was directed to remove one line of poles from Hudson street. The Harlem Electric Light company was ordered to take down at once all its old iron poles not in use.

The Western Union company asked permission to put up new poles in St. Nicholas avenue to replace six old ones. The application was denied. The Metropolitan Telephone & Telegraph company was ordered to remove one of its two lines of poles in Water street, and the Western Union was directed to remove one of its two lines in Hudson street.

Several applications were presented for permits for construction or the making of overhead connections, but the mayor promptly and decisively refused to consider them. "It is of no use making applications for such permits," he said. And although Mr. Moore, of the East River company, asked the board for a permit for an overhead connection that, in his opinion, was of vital importance to the public as well as to his company, the mayor declined to consider the subject, and told him that any communication he had to make must be formally presented to the board.

The engineer's report draws out a busy programme for work in the early future. It proposes to have electric light and power subways on the east side of Sixth avenue from Fourteenth street to Eighteenth street, on the west side of Sixth avenue from Fourteenth to Twenty-fourth streets, on the south side of Fourteenth street from East to Sixth avenue, and in Twenty-ninth street from First to Seventy-ninth street from Park avenue to First avenue, and in Lexington avenue from Sixty-fifth street to Seventy-ninth street. The mayor seemed much gratified with the report, and the construction company was ordered to begin work at once.

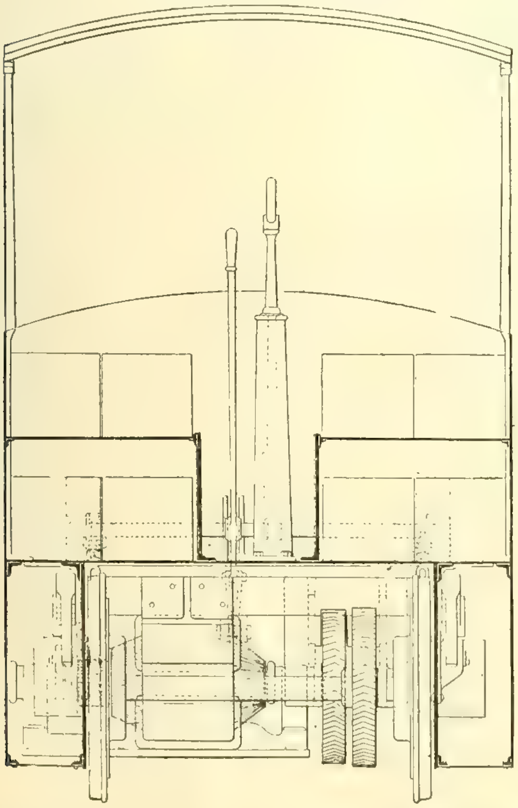


FIG. 1.

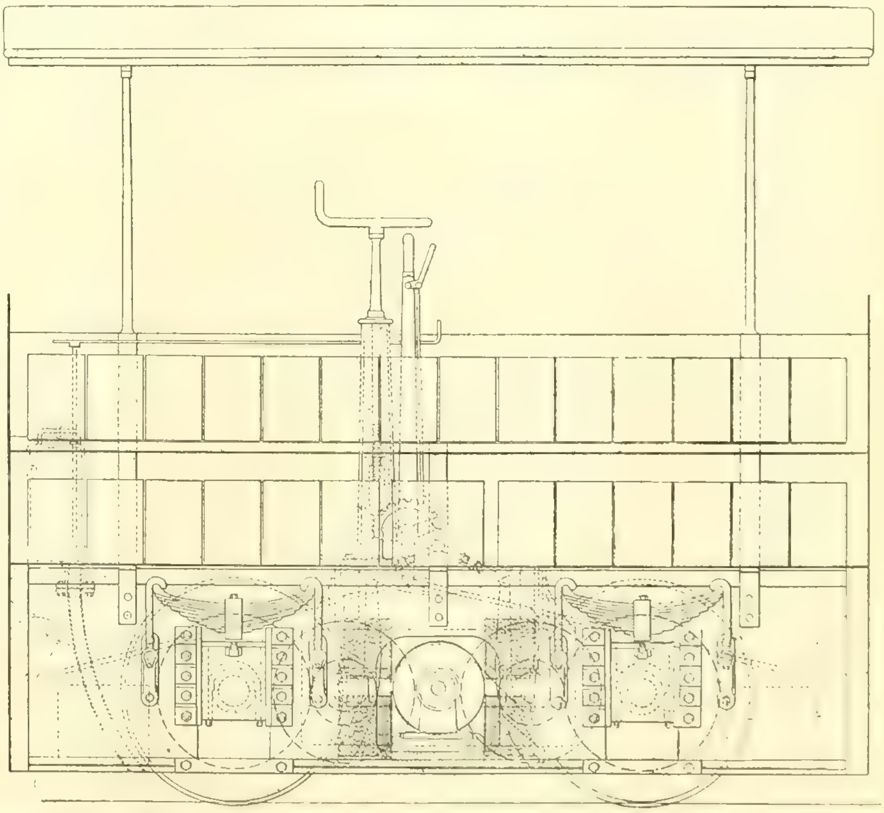


FIG. 2.

ELECTRIC LOCOMOTIVE ON THE BIRMINGHAM TRAMWAY.

In connection with this meeting a somewhat [illegible] fact was noted: there were no evidences whatever of the chronic opposition that has been maintained [illegible] recently by the United States company to the [illegible] of the board. Among other reasons, this might possibly be accounted for by the fact that the absorption of the United States concern by the Westinghouse company is reported, and the new regime is said to be very decidedly in favor of adopting any practicable plan for putting the wires underground.

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THE subject of special interest in New York city at the present time is the project for rapid transit. Electrical engineers are called upon to furnish a solution of the much-discussed problem.

AN English theater manager, in a recent interview, speaks of the fact that his insurance of late has been lessened, as one of the great advantages following the introduction of the new system in his place of amusement.

[illegible] states that at present 266 [illegible] States are operating electric light plants. The statistics show that 21,313 arc lights and 55,890 incandescent lamps, [illegible] are maintained [illegible]

[illegible] usual line appears in [illegible]

[illegible] of making [illegible]

[illegible]

place him in position so that the lines of force can be utilized to extract the cause of the difficulty. Several successful operations are reported, and it is likely that the owners of the station will soon charge a royalty in each case.

THE Druggists' association of Chicago continues its agitation against the telephone company. It has been flooding the legislature during the week with petitions for the passage of the Baker-Eckhardt bill. A member of the committee last week announced the intention of the association to keep up the fight as long as there was a legislature in the state.

PROF. EDWARD L. NICHOLS read an exhaustive paper on "The Efficiency of Methods of Artificial Illumination" before the American Institute of Electrical Engineers at the last meeting. The paper, with the illustrations, appears in this issue. It is an extremely able paper, and embodies the results of a large number of tests made by Professor Nichols.

A SUMMARY of the recent decision of the English Court of Appeals in the case of Gaulard & Gibbs is given elsewhere. The London *Electrical Review*, "from the purely selfish point of view," is glad that anybody can make transformers now, though it feels that "Gaulard & Gibbs are morally entitled to their system, and that it is exceedingly hard on them to lose the benefits of their early work and indomitable perseverance." The *Electrical Engineer* pays "a tribute of praise to the value of Gaulard & Gibbs' work," but is not disappointed in the adverse decision of the court, nor is the *Electrician*, which believes the judgment, "can hardly have surprised any one who is at all conversant with the facts of the case."

SECRETARY WINDOM has issued instructions to customs officers which will be of interest to manufacturers of electrical apparatus who intend to exhibit their goods at the Paris exposition. The instructions direct the officers to admit articles free on their return from Paris on the following conditions: Shippers at the time and port of exportation shall file at the customhouse a manifest showing the marks and number of packages, together with an invoice of statements specifying the contents of such packages (which documents may, if the shippers so desire, be filed by S. P. Tuck, assistant commissioner-general of such exposition, whose office is at No. 1 Broadway, New York, and who will act as their agent for such purpose), and upon the return of the packages produce certificates either from the director or other proper officer of the said Paris exposition duly authenticated by a United States minister or consular officer, or by a statement of the consignees at the foreign port from which the reimportation may be made, certified by a proper officer of the customs at that port, and required by department circular of March 31, 1886, which documents shall fully identify the goods.

THE report of the last meeting of the New York Board of Electrical Control, which is published in this issue, shows that Mayor Grant is still decided in his policy of refusing permission to companies to erect poles for overhead wires. There was no such excitement at the last session as characterized the previous meeting. In this issue is also published a report of the proceedings of the New York Electrical society. The members discussed the underground problem [illegible] the situation in New York city. President Pendleton seemed to think [illegible] the companies could carry on their [illegible] if they were required to bury their wires. Incidentally he referred to the [illegible] system [illegible] in a way that [illegible] Prof. Barrett. He said he had [illegible] reason for considering [illegible] successful. Prof. Barrett would [illegible] He asserts with great positiveness that of all successful in[illegible] more successful [illegible] underground system. Mr. [illegible] at the meeting, [illegible] more hopeful spirit, [illegible] to solve, he did not consider the difficulties insurmountable. Other speakers treated the subject in about the same way. Dr. Wheeler, expert of the Board of Electrical control, referred to several interesting results which had recently been obtained with underground cables.

THE clause of the New York law which provides that no reports of electric executions shall be published beyond the mere statement of fact, will probably be repealed. It will be a dead letter if the legislature does not act. There seems to be but one opinion in New York concerning the provision of the law. An exchange says: "The provision of the law so criticised should be repealed. The true way to avoid sensational accounts of executions is not to have sensational executions. The people like to read about horrors, though they disapprove of them, and the state has no right to perpetrate a horror and then insist that nothing shall be said of it. What we are striving to do in the matter of executions is to hit upon some method that shall not be spectacular, cruel, revolting; and when it is discovered the newspapers will not waste their labor in trying to make an execution sensational that has in it none of the elements of sensationalism. The people abolished hanging because the accounts of hangings in the newspapers shocked their best feelings; and they have a right to know whether in substituting execution by electricity they have made a step forward in the way of decency, or backward toward brutality. Electric execution must stand the same test of publicity that hanging had to stand."

A PARIS correspondent had a conversation with M. Secretan, president of the copper syndicate. When asked what he thought of the situation, he said: "We will know how to manage better next time." He remarked: "I see nothing criminal or selfish in the syndicate whatever. The people don't eat copper! Do they in your country? It is not like wheat. People who haven't money enough needn't buy copper. That's all. We didn't have luck. Two months ago we had $60,000,000 worth of copper on our backs. It took half a million francs daily to take up the current contracts, and not a single smelter would buy. We cabled to the American mine owners that new and more favorable arrangements would have to be made. While awaiting answer M. Deufert Rochereau, the president of the Comptoir d'Escompte, loses his head, runs home and blows his brains out. At the same moment cablegrams were rushing into Paris from America, granting the rearrangement desired. Had M. Deufert Rochereau's death not given the whole thing away, the copper syndicate would be to-day a confessed success."

The council of the Comptoir d'Escompte, which became involved through its connection with the copper syndicate, has issued a circular, in which it is stated that the death of M. Deufert Rochereau, the managing director of the concern, created such a panic among the depositors that the bank was compelled, despite all the measures it had taken, to appeal for aid to the Bank of France and the leading financial houses in order promptly to obtain sufficient funds to insure the proper working of the organization. One stockholder took the initiative and applied to the Tribunal of Commerce for the dissolution of the company and the appointment of a provisional administrator, but the petition was denied. The Tribunal has also decided that it will not appoint a liquidator, but has nominated MM. Moreau and Monpchicourt provisional administrators, with power to summon a meeting of the shareholders to decide upon the question of dissolution. The proposition to dissolve the concern was not opposed by the council, as it was accompanied by a proposal to establish a new company which would be favorable to the shareholders, and a new company could not be formed with advantage until power was granted to transfer it to the present organization and its connections, in which a break must be avoided at any cost. Owing to the urgency of the matter, it was thought impossible to submit the question to a general meeting of the shareholders, as the statutes require that a month's notice be given of such a meeting.

The Efficiency of Methods of Artificial Illumination.[1]

BY EDWARD L. NICHOLS

Of human industries of the present day none perhaps, save those which have to do with providing the race with food, clothing, shelter and fuel, is more important to the cause of material welfare than that which deals with the production of artificial light, and he who seeks a means of measuring the material civilization reached by a nation

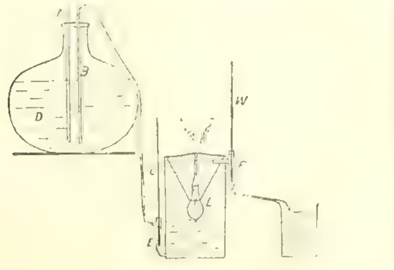


FIG. 1.

might find an excellent criterion in the progress which it exhibits in the art of illumination.

The problem of comparing the various methods of artificial lighting which are in vogue at the present day is one of great interest, whether we view it from the commercial standpoint, taking the cost of production as our controlling factor, or from the broader basis of relative usefulness, cost being relegated to a secondary position, or, finally, from the purely scientific point of view. From whichever side we approach this question, we are led inevitably to the consideration of certain elements which are alike of scientific, utilitarian and commercial importance.

At first sight the attempt to determine the relative value of two sources of light would seem to be a simple matter. The number of factors, however, which enter into such a determination is surprisingly large, and many of them are of a character which makes it difficult to give them definite and complete expression. Of these the greater part are, indeed, completely left out of account altogether, for the sake of simplicity, and we content ourselves with an antiquated and totally insufficient measure of our sources of illumination, which we call candle power. It is to these other elements which enter into the question of the character of artificial light—such, for instance, as have to do with its quality—but which are, as a rule, quite lost sight of, to which I would ask your attention this evening, together with a discussion of those which are commonly made use of in photometry. If, in so doing, I am led to speak of methods which belong to the realm of pure science, I trust that you will agree with me in thinking that the results are not unimportant, even to those whose interest in the problem of the production of artificial light is purely utilitarian.

In the important question of the efficiency of a light-producing machine or process, the practice of to-day is very far from having reached that degree of exactness of expression which we demand in other cases of the transformation of energy. In electric lighting the energy expended is readily determined in absolute measure, or in that excellent practical unit, the watt. In lieu of any attempt to express the useful energy obtained, however, we still content ourselves in practice with that most unscientific unit, the candle power, based upon a source of illumination which is particularly subject to fluctuations of intensity and color. Even as used in the Bunsen photometer the shortcomings of the standard candle are sufficiently apparent, but no one who has not attempted to study it by methods which make it possible to detect changes of color as well as of brightness, can fully appreciate its fickleness.

Such as it is, we do not moreover make the best of the standard candle as a basis of comparison of artificial lights. We speak of a 16 candle incandescent lamp, for instance, meaning oftentimes "mean spherical candle power," and then we compare it with a petroleum or gas flame, measured in the horizontal plane only, much to the disadvantage of the electric lamp. The study of the distribution of intensities in accordance with the very complete system devised for that purpose by the Franklin Institute committee in 1884, affords an invaluable means of comparing the performance of various types of incandescent lamps; but the adoption of "mean spherical candle power," as obtained by

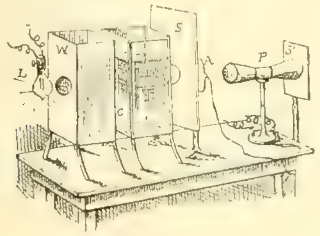


FIG. 2.

that method, is to say the least, misleading when it comes to the comparison of electric lamps with candles, oil or gas. It is to be hoped that when the present confusion of methods of measuring candle power now existing in the electric lighting establishments in this country is supplanted by a recognized system, the fairer standard already established by law in England, viz., mean horizontal candle power, may be adopted. It is, however, in the comparison of arc and gas lamps that the latter are put at the greatest disadvantage. [illegible] mean spherical candle power [illegible] the angle at which [illegible] the greater part of its rays. Indeed [illegible] is not with the actual intensity, even in this most favorable position, with which we have to do [illegible] nominal candle power which the arc, as a matter of fact, never approaches.

The electric arc stands quite alone for the purposes to which it is adapted, and need fear no rivals. It does not need to be estimated upon any fictitious basis, and the continuance of the pernicious practice of ascribing to it powers of illumination which it does not possess must, in a great measure, be charged to the account of the standard candle; for with the best intentions in the world, the comparison of sources of light differing so widely [illegible] the candle and the electric arc, is nothing more than a rude approximation, leading by its very inaccuracy to the temptation of the grossest exaggeration.

There are fortunately better methods of estimating the efficiency of a lamp than that which is based upon candle power.

We may, for instance, determine the ratio of the energy of the light-giving radiation to that of the total radiation of the source of illumination. The efficiency of the incandescent lamp according to this definition, has been recently determined by Ernest Merritt,[2] of the physical laboratory of Cornell University. Mr. Merritt followed two independent methods of investigation. In his first experiments the lamp was placed in a calorimeter constructed entirely of glass, Fig. 1, through which a constant flow of water was maintained. The temperature of the water upon entering

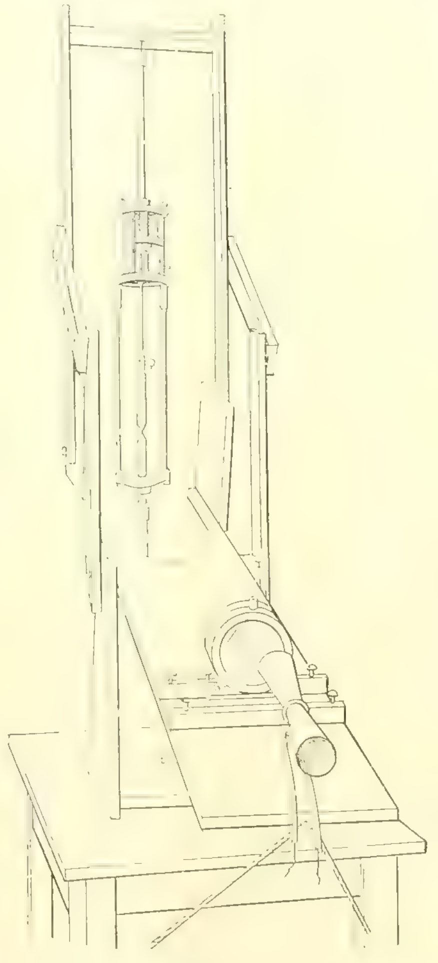


FIG. 4.

and upon leaving the calorimeter was measured by means of the thermometers E and F. From this difference of temperature and the amount of water discharged in a given time, the heat absorbed by the calorimeter was calculated, proper corrections for loss of heat by radiations, etc., being applied. Now the water with which the calorimeter was filled is nearly transparent to the light-giving radiations from the lamp, and almost entirely opaque to the longer wave lengths which constitute the so-called heat spectrum. To have assumed it to be entirely so would, however, have involved very considerable errors, and the diathermancy of the calorimeter on the one hand and its power of absorbing the luminous wave lengths on the other, were accordingly carefully determined by methods long since elaborated and made use of by Melloni, and by his distinguished English follower, Professor Tyndall. By applying these and other necessary corrections, we are able to calculate very accurately in watts the non-luminous radiation from the lamp. The ratio of the total radiation, obtained either by submerging the lamp in a metallic calorimeter or by direct computation from the current and electromotive force, gives the actual efficiency of the lamp considered as a light-making machine. The result is not a gratifying one when we compare this process with most others in which energy is transformed. The efficiency of the best types of incan-

[illegible] diagram, Fig [illegible]

E. M. F.	W.	C. P.	L.	L/W	L/C. P.
74.2	34.6	0.9	0.18	0.005	[illegible]
[illegible]	56.2	[illegible]	0.68	.012	0.14
97.8	64.6	[illegible]	[illegible]	[illegible]	[illegible]
100.3	69.3	8.9	[illegible]	.023	0.18
[illegible]	[illegible]	14.6	[illegible]	.036	0.20
[illegible]	84.4	[illegible]	4.57	[illegible]	0.28
124.1	[illegible]	38.2	7.46	.065	[illegible]

In this table W is the total energy in watts; L the energy of the light, also measured in watts, and C. P. the candle power.

The second method pursued by Mr. Merritt was intended rather as a check upon the results already obtained, than in the expectation of gaining further data. The rays of the lamp were allowed to fall upon the face of a delicate thermopile placed at a distance of about 60 c. m. The thermopile was in circuit with a low resistance galvanometer of the well known "tripod pattern" of Sir William Thomson. The deflection of the galvanometer was taken as a measure of the total radiation, luminous and non luminous, which fell upon the face of the pile. A cell containing a solution of alum was now interposed, and the reduction in the galvanometer noted. The arrangement of this apparatus is shown in Fig. 2.

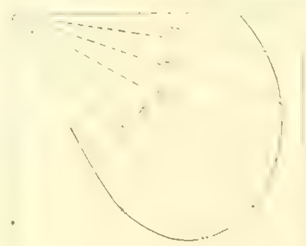
An aqueous solution of alum fulfills much more nearly the desired condition of complete opacity to "dark heat" and complete transparency to the rays of the visible spectrum than any other substance, but a certain small percentage of the longer wave lengths will pass through such a bath, and a considerably larger percentage of light-giving rays will be cut off by it. The proper corrections are, however, easily determinable, and when in this case they had been determined and applied, the ratio of total to luminous radiation was found to be in gratifying agreement with the efficiency obtained by the calorimetric method already described. (See Table II.)

TABLE II.

[illegible]

An Edison 16 C. P. Lamp. Resistance [illegible] ohms.

E. M. F.	W.	C. P.	L.	L/W	L/C. P.
63.0	25.4	0.3	0.42	0.016	[illegible]
74.6	[illegible]	[illegible]	0.77	[illegible]	0.79
85.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
99.0	[illegible]	6.3	4.30	[illegible]	0.68
110.0	[illegible]	15.2	[illegible]	[illegible]	0.49



[illegible]

1 Read before the American Institute of Electrical Engineers, March 12, 1889.

2 Ernest Merritt, American Journal of Science, [illegible]

Lamp C

Western [illegible] Lamp [illegible] resistance [illegible] 402 ohms.

E. M. F.	W.	C. P.	L.	L / W	L / C. P.
[illegible]	[illegible]	0.4	[illegible]	0.021	1.27
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.76
[illegible]	[illegible]	[illegible]	[illegible]	.044	0.48
117.0	[illegible]	[illegible]	3.19	.048	[illegible]

FIG. 6

Lamp D.

Western [illegible] Lamp Resistance [illegible] 152 ohms.

E. M. F.	W	C. P.	L.	L / W	L / C. P.
[illegible]	25.8	[illegible]	0.53	[illegible]	[illegible]
[illegible]	36.0	1.6	0.97	.027	0.62
60.5	52.0	[illegible]	[illegible]	.039	[illegible]
[illegible]	[illegible]	11.0	3.95	[illegible]	[illegible]

Lamp E.

Bernstein [illegible] C. P. Lamp. Resistance [illegible] ohms

E. M. F.	W.	C. P.	L.	L / W	L / C. P.
[illegible]	[illegible]	0.2	[illegible]	0.008	1.00
[illegible]	30.8	0.5	[illegible]	.013	0.84
[illegible]	[illegible]	[illegible]	[illegible]	.018	0.57
[illegible]	53.2	[illegible]	2.03	.038	0.50

It is interesting to compare these results with some obtained by still another method. Captain Abney and Colonel Festing, in the proceedings of the Royal society, have described a series of elaborate studies of the radiation of the incandescent lamp. The portion of their very important investigation which has a bearing upon the efficiency deals with the exploration of the spectrum of the lamp, under various degrees of incandescence, by means of an exceedingly sensitive thermopile. The energy of the visible spectrum of most sources of light is so minute that it has generally been deemed impracticable to measure it in this way. Captain Abney and his co-worker have, nevertheless, secured measurements covering not only the extensive regions of the so-called heat spectrum lying inside the red, but also the shorter wave lengths which constitute the visible spectrum. Their results are shown graphically in Fig. [illegible].

One of the British Electric company's lamps was subjected to measurement in six different states of incandescence, corresponding to 33.6, 60.2, 93.8, 116.4, 130.8 and 150.5 watts respectively. The curves show the inten[illegible] the spectrum. When the above amounts of energy were expended in the filament, and the total area inclosed by each curve affords a relative measure [illegible] lamp in the state of incandes-

[illegible]

with the results [illegible] Merritt. The ratios are

Watts	Efficiency.
150.5	5.55 per cent.
130.8	5.15 "

The corresponding values for lower states of incandescence are all smaller than the above.

It will be seen that these [illegible] in complete agreement with those obtained with the glass calorimeter and by the method of Melloni. We have, indeed, reason to feel that our knowledge of the [illegible] of the incandescent lamp, in so far as it can be expressed by the ratio of luminous to total radiation is well grounded, and that we are in position to determine the light-giving efficiency of any type of glow lamp in any condition of incandescence with the same certainty and exactness which is attainable in the measurement of other machines for the transformation of energy.

The average net efficiency of the incandescent lamps of to-day, for we may have untouched for the present the efficiency of the process by which the latent energy of fuel from which the current is generated has been converted into electrical energy, is rather below than above 5 per cent., and since the ratio of total radiation to light-giving radiation increases but slowly as the temperature of the radiating body rises, the efficiency is not likely to be increased in any very marked degree until we shall have learned how to suppress altogether these long wave-lengths which yield us dark heat, and are able to limit the vibrations of our source of light to that brief octave which comprises the wave-lengths, to which alone the human retina responds.

Whether this great step is to be made by robbing the glow-worm and fire-fly of their secret, as has been suggested in a recent address by the director of the Sibley College of Mechanical Engineering,[2] or by development along the lines sketched the other evening by Professor Brackett at

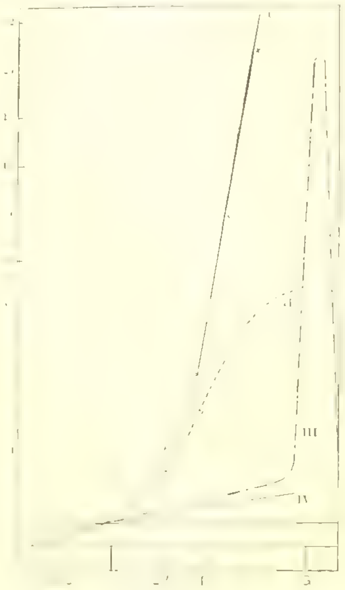


FIG. 8.

the meeting of the Electric club, or by the application of some principle as yet unconceived, we know not. Meantime, we have in the methods of artificial lighting of to-day abundant material for study and investigation.

The investigation of the efficiency of the arc light, by the methods under consideration, is a much more difficult matter than the same determination in the case of the incandescent lamp. The radiating surface of the latter is very nearly of the same temperature throughout, and the ratio of total radiation to luminous radiation, obtained for the bundle of rays sent out in a single direction, gives us at once the measure of the efficiency. In the arc we have, however, a light-giving area of great btilliancy in the immediate neighborhood of the arc, and the temperature of the carbons falls with great rapidity from the maximum at the point and crater to regions which are at a red heat.

The entire light-giving area is included between the line surrounding the positive carbon, which is at red heat, and the corresponding line upon the negative carbon. Between these two lines we pass rapidly through regions, the light from which varies with the degree of incandescence by in[illegible] from that which a red hot surface is [illegible] to that coming from carbon at the highest temperature which that substance can be made to [illegible] the curve of distribution of candle power [illegible] vertical plane [illegible] know, a very peculiar [illegible] with alum cell inter[illegible] the energy of the light giving rays, the [illegible] the face of the pile will [illegible] which the apparatus is [illegible] degrees below [illegible] the amount indicated will [illegible] greater than in the horizontal plane.

[illegible]

Now, the surface of total radiation is much larger than that from which the light-giving rays emanate. It includes, in addition to the incandescent surfaces near the arc, all those portions of the carbons which are heated, either by conduction or by the current.

The amount of heat radiated from regions which are below the red heat is very considerable, and forms an important factor in the determination of the efficiency. Were

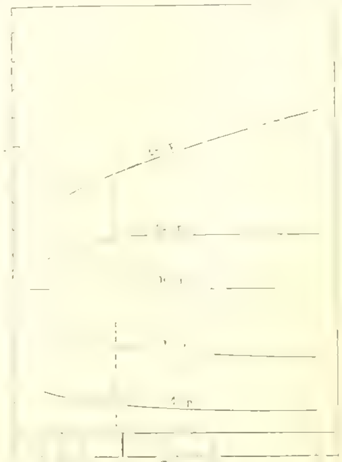


FIG. 9.

the distribution of total radiation in the vertical plane identical with that of the light-giving rays, the measurement of their ratio with the axis of the thermopile in any plane which passes through the arc, would give us the efficiency of the lamp; but the curve of distribution of total radiation is not the same as that of candle power, and the ratio in question is a function of the plane which the axis of the pile makes with the horizon. It becomes necessary, therefore, to make an exploration of the entire zone through which the lamp sends out rays, determining the ratio of total to luminous radiation for each angle, and then to integrate the results. Such an investigation is now in progress under my direction, and H. Nakano, who is carrying on the experiments, has reached some exceedingly interesting results. The research will soon be ready for publication in its complete form, and it will afford us much more definite data concerning the radiations of the electric arc than we now possess. It will not be out of place even now to say a word concerning the method which is being employed, and the general character of the results already obtained.

The first measurements were made by the second method employed by Mr. Merritt, the thermopile in the horizontal plane. The lamp subjected to measurement was of the long arc type, with 9 amperes of current and 45 volts. The efficiency in this plane was found to be surprisingly small. It was found moreover, to vary in marked degree with the diameter of the carbons used, increasing as the diameter decreased to the point at which the carbons were rendered hot by the current, when, as might be expected, it fell off again.

The lamp was then mounted in a frame which also carried the thermopile and alum bath, and which was so constructed that measurements could be made at any desired angle. All necessary changes of angle could be made without varying the distance from the arc to the face of the pile, or the relation of the alum bath to the latter. By means of

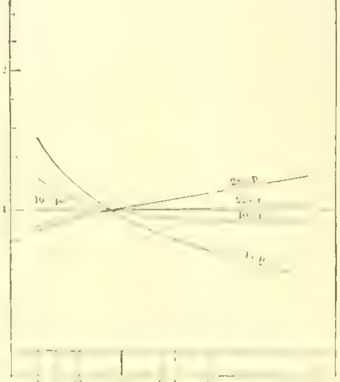


FIG. 10.

this apparatus, which is shown in Fig. [illegible], it has been found possible to determine the ratio of total to luminous radiation throughout the zone of radiation of the lamp, and to plot the curve of distribution of each.

Without entering into the details of an incompleted research, I may indicate the general character of the results by means of a diagram. The curves shown in Figs. 5 and 6 are those relating to a "long arc" lamp with carbons .45 inch in diameter. They represent respectively the distribution of luminous and total radiation emanating from the lamp. The radii show the positions for which measurements were taken; distances measured along these lines

from the origin to each curve gave the relative intensities of light-giving and total heat energy in each position.

The curve of luminous radiation corresponds in form with that of candle power. The distribution of total radiation, however, differs widely from these and the ratio, $\frac{\text{luminous energy}}{\text{total energy}}$, is a function of the angle which the line of measurement makes with the horizontal plane. The values of the efficiency in the case in question for the various angles at which measurements were made, are given in Table III. They form the basis for the curve in Fig. 6, which is the diagram of efficiencies of the arc light under the conditions of operation already stated

TABLE III.

Efficiency of an arc lamp; after measurements by H. Nakano.

Angle	Efficiency = $\frac{\text{Luminous radiation}}{\text{Total radiation.}}$
0	.0545
10	.0901
20	.1228
30	.1506
40	.1552
50	.1050
60	.0676
63	.0492

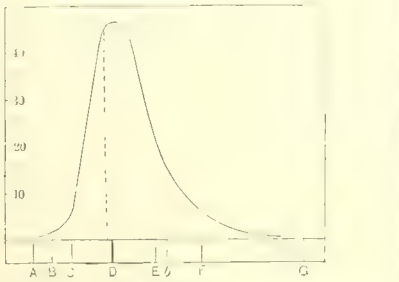


FIG. 11.

The integration of these values gives as the mean efficiency of the arc lamp in question, .104, or 10.4 per cent.

The ratio of the radii of two semi-circles, the areas of which equal the areas inclosed by the curves of luminous and total radiation, gives us a measure of the "mean spherical" efficiency of the lamp. This ratio in the case of the lamp to which these curves refer is very much smaller than the generally accepted values of the efficiency of arc lamps, expressed in terms of the candle power per watt, would lead us to expect. The intensity of the arc is, however, seldom expressed in mean spherical candles, and there are few data relating to the candle power of this source of light upon which to found satisfactory estimates. On the one hand we find it stated, doubtless correctly, that the mean light-producing efficiency of the eleven dynamos, tested at the International Health Exhibition, held in London in 1884, was 1,440 candles per horse power [6] while the glow lamps only yielded 175 candles, and it is with estimates similar to the above with which we have generally to satisfy ourselves in comparing arc and incandescent systems of illumination.

For the purpose of deciding whether the results of Nakano's method of determining the ratio of luminous to total radiation are compatible with our other sources of knowledge concerning the arc light, we must make use of mean spherical candle power as our basis of comparison.

Very careful measurements of the mean spherical candle power of two arc lamps of representative and successful commercial types were made in the physical laboratory of Cornell University,[7] following the method of the Franklin Institute committee. Both of these lamps were rated at 2,000 candle power. They were maintained by dynamos of the types for which they had been especially designed, working under normal conditions. One of the lamps gave a mean spherical candle power of 295, when working in series with nine other lamps of the same construction. When placed in circuit alone, the candle power rose to 348. The energy expended in the lamp in each case was 550 watts, and the efficiency accordingly 1.8 watts and 1.6 watts per candle.

The other lamp was found to reach 609 mean spherical candles at the cost of 601 watts. An inspection of the result obtained by the Franklin Institute committee would lead us to regard these as extreme values, between which the performance of almost all arc light would lie as a rule, nearer the lower than the upper of these limits. The efficiency of arc lights, then, expressed in mean spherical candle power per watt is frequently as low as 1.5 times that of the incandescent lamp, and rarely, three times as high. Now the mean efficiency of the arc lamp under discussion, *i. e.*, the ratio, $\frac{\text{luminous radiation}}{\text{total radiation}}$, according to the measurements of Mr. Nakano, is almost exactly 10 per cent. The efficiency of incandescent lamps, defined in the same way, according to Mr. Merritt, may, as we have seen, be taken at about 5 per cent. The ratio is 2:1 in favor of the arc lamp which lies within the limits determined by comparison of candle power and watts.

Small as these values for the efficiency of the electric light are, they show marked improvement over the efficiency determined in a similar manner for sources of illumination which depend upon the incandescence of carbon by direct combustion. More than a quarter of a century ago, Julius Thomsen[8] presented before a gathering of Swedish men of science, the results of an investigation of the energy consumed in the sperm candle, and in various oil and gas flames. His memoir bore the suggestive title of the "Mechanical Equivalent of Light," and is one of the earliest contributions to our knowledge [illegible] luminous radiation.

The instruments employed in Thomsen's experiments were the thermopile and galvanometer; the indications of [illegible] were reduced to absolute measure by determining the deflection produced by the radiation from a glass globe filled with hot water. The total loss of heat by radiation which this globe suffered was calculated from its rate of cooling, using Dulong and Petit's law. The [illegible] of the globe was 1,351 grains. Its total loss of heat per minute at 70 degrees C. was 250 calories; the loss of heat by radiation at the above temperature when the air of the room was at 17 degrees was 102 calories per minute. Under these conditions the influence of the globe of water upon the thermopile placed at a given distance, was observed. A luminous body having been substituted for the globe, its influence on the pile was likewise noted, and its total radiations in calories calculated by comparison of the deflections produced in the two cases.

For a sperm candle burning 8.2 grains per hour, the total radiation estimated by this method was 210 calories per minute. Other flames gave out proportions of heat nearly in proportion to their candle power, as will be seen by inspection of Table IV.

TABLE IV.

Calories per candle power radiated by various flames, according to Julius Thomsen:

Source of illumination.	Candle power.	Calories per candle.
Sperm candle	1.	2??
Gas flame	1.2	261
Gas flame	7.7	1??
Moderator lamp	8.6	199

The luminous energy was obtained by a method similar to that pursued by Merritt in the experiments already described. A bath containing a layer of water 20 c. m. in thickness was interposed between the lamp and the thermopile, and the indications of the galvanometer noted. The results were based upon the assumption that the cell absorbed 13 per cent. of the light and all of the dark rays. This estimate is doubtless faulty, and may involve a reduction of several per cent. from the values given by Thomsen. His results, uncorrected, are as follows:

TABLE V.

Energy of luminous radiation of various flames in calories, according to Julius Thomsen.

Source.	Candle power.	Luminous energy per c. p.
Candles	1.	4.4 calories
Moderator lamp	6.25	3.9 calories.
Moderator lamp	8.6	4.1 calories.
Gas	7.7	4.2 calories.
Gas	1.2	3.7 calories.

The energy of the light-giving rays per candle power of light produced is then, according to Thomsen, very nearly the same for the flames of the candle, oil lamp and gas burner. This conclusion has been abundantly confirmed by spectro-photometric observations of the quality of the light which they emit. It appears, moreover, from these observations, of which I shall have occasion to speak at length presently, that the temperature of the incandescent particles in such flames agrees very closely indeed with that of an incandescent lamp, consuming 5 watts at 16 candle power, being, as a rule, lower, rather than higher, than the latter; and the calculation of the energy of such a lamp in calories per minute, making use of the data furnished us by the investigation of Abney and Festing, or of Merritt, affords most satisfactory evidence of the accuracy of Thomsen's results. Let us take for example the case of an incandescent lamp in which 5 watts per candle power are expended, and in which the ratio

FIG. 12.

$$\frac{\text{Luminous radiation}}{\text{Total radiation}} = .05.$$

The energy converted into light in such a lamp is .25 watt.

Now,

1 gramme-calorie = 4.2 × 10[7] ergs.

$$1 \text{ watt} = 10^7 \text{ ergs} = \frac{1}{4.2} \text{ gramme-calories per second.}$$

$$.25 \text{ watt} = \frac{.25 \times 60}{4.2} \text{ gramme-calories per minute and}$$

[illegible]

FIG. 13.

[illegible] upper and cooler portions, which do not reach the [illegible] the thermopile at all. The relation which the [illegible] convection cannot be determined, and the determi[nation] of total radiation from the light-giving portions alone is of little value. It is only in the matter of gross efficiency, therefore, that we can institute a comparison between electric lamps and the older methods of illumination, and the gross efficiency of the former depends upon the efficiency of production of electric current. Under conditions, such that 10 per cent. of the total energy of the fuel consumed is converted into electricity—conditions which are, I believe, rarely attained by our present methods—the gross efficiency of an incandescent lamp, of which the net efficiency, determined by the methods which I have already described, is 5 per cent., would be .5 per cent.; a value which is five times greater than that of a lamp burning the kind of gas used by Thomsen, and which stands in the ratio 5 : 3 (or, probably, rather more than that) to the gross efficiency of an oil flame. These flames must, of necessity, vary very widely with the quality of the fuel consumed, and with the condition under which combustion is maintained.

If we apply a similar method of computation to the values given by Mr. Preece in his recent address at the Bath meeting of the British Association for the Advancement of Science[9], assuming that the conditions under which each illuminant is consumed are such that the temperature of the incandescent carbon equals that which is maintained in the filament of an incandescent lamp at 5 watts per candle with a net efficiency, as before, of 5 per cent., a set of conditions which can be attained in practice only in the most perfectly constructed oil and gas lamps, and which are fulfilled in many of the best of our incandescent lamps of to-day, we obtain the following results:

TABLE VI.

Gross efficiency of various illuminants deduced from the values given by Preece. The heat equivalent of a candle is assumed to be 3.6 gramme-calories per minute.

Illuminant.	Watts per candle. (Preece.)	Gr'm'e-calories per minute per candle.	Luminous radiation / Total radiation = gross efficiency.
Tallow	124	177[illegible]	[illegible]
Wax	94	134[illegible]	[illegible]
Sperm	86	123[illegible]	[illegible]
Mineral oil	80	114[illegible]	[illegible]
Vegetable oil	57	81[illegible]	[illegible]
Coal gas	68	[illegible]	[illegible]
Cannel gas	48	[illegible]	[illegible]

In considering these values it should be borne in mind that coal gas is a fuel which has been obtained by the previous expenditure of considerable energy. We [illegible] as our basis the consumption of coal necessary [illegible] production of a candle power of light, [illegible] the combustion within the gas flame itself, the [illegible] the efficiency of coal gas as an illuminant would be considerably reduced.

We have already seen that there are excellent experimental grounds for the statement that the gross efficiency of the incandescent lamp is [illegible] per cent. of the total energy of the [illegible] processes [illegible] the latter [illegible] as they are [illegible] of the gross efficiency of candles [illegible] We are in possession [illegible] the means [illegible]

[illegible]

[6] Julius Maier. Arc and Glow Lamps, p. 3[illegible].

[7] The Photometry of Arc Lights. Thesis by Benjamin W. Snow, 1885. MS. in the Library of Cornell University.

[8] Julius Thomsen. Das Mechanische Equivalent des Lichtes, *Poggendorff's Annalen, Bd.* 125, p. 348.

the degree of superiority which the electric light possesses over those illuminants in the important matter of the heating effect upon the surrounding atmosphere. Gas and oil flames deliver in the neighborhood of 1,000 gramme calories of heat per minute to the room for each candle power, of [illegible]. An incandescent [illegible] delivers only 72 gramme-calories per candle power.

The net efficiency of the incandescent lamp may be raised somewhat by increasing the temperature of the carbon filament, and, indeed, it has already been somewhat raised by the introduction of the new "3 watt" lamps. These lamps have been excluded from this discussion because we have as yet no complete data with reference to them, and because it seemed desirable, aside from that, to institute comparisons between sources of illumination in which the degree of incandesence was the same, and for all of which, consequently, candle power had the same meaning.

When we raise the temperature of our source of light, however, we introduce changes, of which the methods thus far considered take no cognizance.

In increasing the degree of incandescence, the ratio of luminous energy to total energy of radiation is slowly increased, and at the same time the relative brightness of the various rays which constitute the visible spectrum changes. In a word, the quality of the light changes, and we are confronted by important variations which cannot be expressed in candle power.

The investigation of these changes in composition, upon which color depends, involves the study of the visible spectrum of the source of light and the comparison of its intensity, wave length for wave length, with the spectrum of some properly chosen standard. The instrument necessary to this work is the spectro-photometer, by means of which the spectra of the two lights to be compared are brought together in the field of view, one above another, like wave lengths everywhere in the same vertical line. The measurements consist in bringing the two spectra to the same intensity in each of the regions selected for observation successively and in determining the amount by which it is necessary in each case to reduce the intensity of the brighter. A variety of devices have been made use of for varying the brightness of the spectra, and the standards of comparison adopted by different observers have included the candle, the petroleum flame, the gas flame, and the incandescent lamp, maintained at a constant voltage. Thus W. H. Pickering[10] obtained the necessary range of intensities by placing the lamp under inspection upon a sliding carriage, and varying its distance from the slit of the spectroscope. His standard of comparison was a gas flame. H. C. Vogel used as his standard a petroleum flame. Crova,[11] who brought the intensities of the two spectra to equality by means of a polarizing device, adopted the moderator lamp as a standard. Otto Schumann, in his study of the incandescent lamp, made use of a "benzine" candle. The intervention of a revolving disc with open and closed sectors and of wedges of smoked glass have also been applied to the regulation of the intensity, and the method of varying the width of the slit itself, a device due to Vierordt has been found to give good results, where the range of intensities was inconsiderable.

The methods of presenting the results of this class of measurement have differed as widely as the methods of observation and the choice of standards; but it is possible wherever the data are properly given and the character of the standard is known, to reduce them all to a common basis of comparison. When thus reduced these measurements are found to agree in all essential particulars, and they afford us very definite knowledge of the character of the light emitted by the sources of illumination to which the spectro-photometer has been applied.

Fig. 7 shows the form of the spectro photometer recently used by W. S. Franklin and myself in an extended series of observations upon artificial sources of illumination and in the comparison of their spectra with that of daylight.

To the slit of a one-prism spectroscope are attached a [illegible] prisms [illegible] of which rays may [illegible] upper and lower halves of the slit, these rays coming respectively from sources of illumination [illegible] at right angles to [illegible]s of the collimator tube. The standard of illumination [illegible] maintained at 16 [illegible] light than [illegible] by means of a [illegible] Nicol's prisms [illegible] and enters the [illegible] spectrum of [illegible] which is placed [illegible] in character [illegible]

The investigations made with this instrument, which have been described in a paper read before the American Association,[12] included the measurement of candle flames, and of various petroleum and gas lamps, also of the lime light, the incandescent lamp at [illegible] of conditions, of the electric arc and of daylight by clear and by clouded sky. The results obtained illustrate the precise character of those differences in composition to the bearing of which, upon the study of the efficiency of artificial illumination, I desire to call your attention.

In the first place it was found that the light of the candle, and of oil and gas flames, although subject to considerable fluctuations from variations of the condition under which combustion occurs, differ but slightly in quality from each other and from that of incandescent lamps maintained at normal candle power. The incandescent material in all is carbon, and it is a significant fact that the average temperature of incandescence is nearly the same in all luminous flames, and that the highest temperature, until very recently at any rate, at which it has been found practicable to maintain the carbon filament of the glow lamp, is very nearly that at which the same material exists under the most favorable conditions in oil and gas flames. Hence it is that the radiant energy per candle-power, as has been shown by Julius Thomsen, is nearly the same for all these flames.

Passing to other sources of illumination, such as the lime light and the electric arc, we find the entire portion of the spectrum lying beyond the yellow increasing more rapidly, regions of longer wave-length than the yellow increasing less rapidly than the candle power; the rate of increase growing steadily as the wave length diminishes from the red to the violet end of the spectrum. Fig 8 shows the results of comparisons of the spectra of the lime light, electric arc, and of daylight, by clear and by unclouded sky, with that of an incandescent lamp maintained at its normal candle power. This lamp, which was chosen as a standard of comparison, was an Edison 16 candle, 100 volt lamp. Its light was precisely similar to that of a "Board of Trade" argand gas burner, showing the same relative brilliancy throughout the whole of the visible spectrum. The measurements were made with the spectro photometer just described (see Fig. 10), the light in every case falling upon the block of magnesium carbonate, and entering the slit of the spectroscope after reflection from the face of the latter. For purpose of comparison the brightness of the standard incandescent lamp has been taken as unity throughout the spectrum. If we make a diagram in which abscissæ are wave-lengths and ordinates, intensities, referred to that of the standard as unity, the curve for this lamp will be a straight horizontal line, with ordinate = 1.

All other spectra are reduced to the same brightness in the region of the *D* line of Fraunhofer, and their brightness in other regions, referred to that of the corresponding wave length in the spectrum of the standard, is shown by means of curves.

Observations were made in ten regions of the spectrum, equi-distant as to wave-length, and embracing the whole of the visible spectrum. It will be seen by reference to the figure that the lime light is relatively much stronger in the violet, and much weaker in the red than the standard. In the arc light this increase of intensity toward the violet is even more marked, but its variation in quality from the lime light is by no means so great, as its exceedingly brilliant, bluish white appearance to the eye would lead us to expect. The source of that appearance and of the very high actinic value of the arc is found, however, in the presence of an exceedingly bright band in the extreme violet. Here the relative intensity of the arc light spectrum rises abruptly about 3 to 20 times that of the incandescent lamp.

Measurements were made upon a long-arc lamp with ½ inch carbons, with 10 amperes and 50 volts and a short-arc lamp with a 20 ampere current. The character of the light was found to be almost identical excepting in this light band in the neighborhood of the *G* line, which is much more prominent in the long arc lamp. The character of the light was found to be much the same at all angles below the horizontal plane.

The only other spectro-photometric measurements of the electric arc with which I am acquainted, have been made upon the Foucault regulator, a lamp with carbons of small diameter. Fairly concordant determinations of the distribution of intensities in the spectrum of this lamp by W. H. Pickering[14], H. C. Vogel[15] and Crova[16], show that the light of this lamp is decidedly bluer than that of the lamps with large carbons in vogue at the present day, the spectrum of the former being about five times as rich in the violet as that of gas or oil flames. Mr Nakano's results, of which mention has already been made, indicate marked increase in the efficiency of the arc lamp as the diameter of the carbons [illegible] and [illegible] of efficiency arises from a [illegible] degree of incandescence, we should expect [illegible] in the shorter wave-lengths [illegible] the case of the Foucault regulator.

Finally, in the case of daylight we find the intensity of the shorter wave-lengths exceedingly great as compared [illegible] illumination. If the spectrum of [illegible] brought into comparison with that [illegible] and the two be reduced to the [illegible] the [illegible] red of the daylight spectrum will be so dim in comparison with that of [illegible] difficult. In the [illegible] the sun's spectrum [illegible] Curve I, Fig [illegible] of the daylight [illegible] day. [illegible] in which the [illegible] method, the [illegible]

[illegible]

Ordinarily, there is considerable absorption of the blue and violet by moisture in the atmosphere and a measurement of daylight under a densely clouded sky gave Curve II. Even under these conditions, with the violet reduced to about one-tenth of the value which it possesses in clear weather, daylight is very much bluer than any artificial light. The light emitted by burning magnesium approaches more nearly to it than any other, being, according to Pickering, considerably stronger throughout the blue and violet than the light from the Foucault arc lamp. Its color, however, is not reinforced by a violet band like that in the spectrum of the electric arc, a region which by its extraordinary brightness has marked influence upon the color of the light.

These variations depend upon temperature primarily, and they may be studied to the best advantage in the spectrum of the incandescent lamp. The radiating surface of such a lamp is at a nearly constant temperature throughout, and it may be given a very considerable range in the matter of incandescence, involving variations in color and total intensity, which are under complete control.

An Edison lamp, similar to that which had been used as a standard in our previous measurements, was subjected to spectro-photometric analysis by Mr. Franklin and myself at 4 candles, 10 candles, 16 candles, 22 candles and 28 candles, successively. The results obtained are shown in Fig. 9

The spectrum of the lamp at 16 candles is taken as of unit brightness throughout, and the other curves show the amount of light of each wave length emitted by the lamp in the above mentioned states of incandescence. Intensities, in every case, are referred to the light of corresponding wave length, given by the same lamp at 16 candles, as unity.

At the red end of the spectrum the intensity increases more slowly than candle power, at the violet end more rapidly. There exists an intermediate wave length for which the brightness is proportional to the candle power. The vertical line in the diagram shows the portion of the spectrum for which this holds true, a point in the yellow at wave length 6,000.

If we suppose the same measurements executed upon a set of lamps in every respect similar to the one in question, excepting that their radiating surfaces are of such size that they give 16 candles, as indicated by the Bunsen photometer when the degree of incandescence corresponds respectively to that at which the lamp actually measured emitted at 4, 10, 16, 22 and 28 candles, there would result a set of curves of the same general character as those in Fig 12. At wave length 6,000 these curves would have a common value, and they would serve to indicate both the quantity and quality of the variation of the carbon filament as a function of the incandescence, candle power remaining constant. The form of these curves is shown in Fig. 10. They afford us data for discussion of the candle as a standard of illumination which could not be obtained in any other way. They show the relative distribution of energy in the spectrum of five lamps, which, according to the indications of the Bunsen photometer, are of equal brightness, but which differ both in the quality and in the total energy of their luminous radiation. Their efficiency expressed in terms of the candle power produced per watt expressed in the lamp, rises rapidly as the incandescence increases. For lamps of the type upon which these measurements were made, for instance, the relative efficiency referred in each case to that of the lamp, the incandescence of which corresponds to that of an Edison lamp at 16 candles, is given in the column headed $\frac{\text{Candle power}}{\text{Watts.}}$ in Table VII.

TABLE VII.

State of incandescence equivalent to that of an Edison 16 candle lamp giving	Relative efficiency referred to that of a 16 candle lamp as unity. Candle power / Watts.	Luminous radiation. / Total radiation.
(1) 4 candles.	.394	.211
(2) 10 candles.	.729	.632
(3) 16 candles	1.000	1.000
(4) 22 candles	1.218	1.368
(5) 28 candles	1.391	1.589

If, however, we retain as the measure of efficiency the ratio, $\frac{\text{luminous radiation}}{\text{total radiation}}$, we can deduce from these curves values coinciding with those reached by the method of the thermopile and alum cell. To this end we must know the above-mentioned ratio for some one candle power and the number of watts necessary to the production of each state of incandescence for which the computation is to be made.

The relative efficiency can then be calculated from the areas inclosed by the respective curves. Were the candle power proportional to the energy of luminous radiation, the values thus obtained would be identical with relative efficiency determined from the relation of candle power to watts. The relative efficiency thus computed (see Table VII) does not coincide with that obtained from the ratio of watts to candle power, however, for the reason that the various rays which make up the visible spectrum do not enter into the production of candle power in proportion to their energy. The most important wave lengths, so far as light-giving power is concerned, are those which form the yellow of the spectrum and the relative luminosity falls off rapidly both toward the red and the violet. The longer wave lengths have, however, much more influence upon candle power than the more refrangible rays, as will be seen by an inspection of the curves, the relative falling off of the red end of the spectrum being compensated by larger and larger accessions in the blue and violet as the state of incandescence increases.

Luminosity is the factor which we must take into account in seeking a complete expression for the efficiency of any source of illumination, and the method to be pursued in the determination of the luminosity must depend upon the use to which the light is to be applied. If we estimate light by its power of bringing out the colors of natural objects, the value which we place upon the blue and violet rays must be very different from that which would be ascribed to them if we consider merely its power of illumination as applied to black and white. In a picture gallery, for instance, or upon the stage the value of an illuminant increases with the temperature of the incandescent material, out of all proportion to the candle power, whereas candle power affords an excellent measure of the light to be used in a reading room.

A number of determinations of the luminosity of artificial light have been made. In the earliest of these by Vierordt,[17] the amount of white light which may be mixed with each color of the spectrum, without producing an appreciable change of tint, was taken as the measure of the luminosity of that color. The result is shown graphically in Fig. 11. The curve indicates the light-giving power of each wave length, estimated in the above manner. The source of light experimented upon was a petroleum flame. The vertical line indicates the region of the spectrum within which—according to the measurements of the quality of light of the incandescent lamp already described—the increase in the brightness of the spectrum is proportional to the candle power. This region corresponds very nearly with that of maximum luminosity of the spectrum.

The luminosity of the blue and violet rays is so very small that in the production of candle power the influence of the very rapid growth of this end of the spectrum with increasing temperature of the lamp, is scarcely appreciable. If we estimate the light-giving value of the different portions of the spectrum by means of the facility with which we can distinguish black characters upon a white ground, the importance of the more refrangible rays is still farther diminished. Thus Mace de Lepinay and Nicati[18] have shown that if yellow and blue light, estimated to be of equal brightness by photometric means, are of such intensity that one can clearly distinguish a printed page when illuminated by the yellow, the same page will be entirely illegible when the blue light alone falls upon it. These observers conclude, indeed, that "The mere distinguishing of objects is due almost exclusively to the illumination produced by the less refrangible half of the normal spectrum;" so that at equal brilliancy "the superiority of yellow sources of light (luminous gas flames, incandescent lamps) over sources richer in blue rays (light of the electric arc) is incontestable." "The only real advantage," they add, "upon the side of the light from the electric arc is when one desires to rehabilitate objects more nearly in the hues which they present in the light of day." This single advantage is one which it is impossible to take due account of, numerically, in an estimate of the efficiency of artificial illumination. It is nevertheless a most important factor in determining the adaptability of a light to nearly all the purposes of everyday life.

Otto Schumann,[19] to whom we owe a most exhaustive study of the light of the incandescent lamp, has determined the luminosity of several types of such lamps at various stages of incandesence. His results, in so far as they apply to a 16-candle Edison lamp, are given in Table VIII.

TABLE VIII.

Luminosity of an Edison lamp at various stages of incandescence, according to Otto Schumann.

			Luminosity of various regions of the spectrum.						
Amperes.	Volts.	Watts.	Red λ 676	Orange λ [illegible]	Yel'w λ [illegible]	Green λ 557	Blue λ [illegible]	Indigo λ [illegible]	Violet λ [illegible]
0 625	87 3	54 6	1 18	4 64	.....	[illegible]	[illegible]	[illegible]	...
.675	90 4	61.3	[illegible]	[illegible]	.	30.35	1 05	[illegible]	..
.727	91 7	68.8	2.24	9 34	[illegible]	[illegible]	1 71	0.34	
.748	97 4	72.9	2 50	10 92	63.28	62.23	2 28	0 47	.....
.823	105 0	86.4	4.06	17 14	[illegible]	[illegible]	[illegible]	0.88	....
.944	112.9	106.7	6 07	28.65	103 0	[illegible]	7.88	1 75	.....
[illegible]	117 6	[illegible]	8.74	27 14	222 0	255 7	[illegible]	[illegible]	0 42
1.035	[illegible]	[illegible]	[illegible]	41 67	263.3	317 7	[illegible]	[illegible]	0.60
[illegible]	124 5	[illegible]	[illegible]	52 30	345 2	472 2	[illegible]	[illegible]	1.04

I have made these values of Schumann's the basis of a set of curves, by means of which the variation in luminosity, with total energy in watts is exhibited (see Fig. 12). It will be seen that the position of the maximum moves slightly toward the violet as the brightness of the lamp increases. This tendency is very slight within the range of temperatures reached by the incandescent lamp. In the arc light we should find the displacement more marked, but in the case of sunlight, in which, as we have seen, the shorter wave lengths are in such preponderance, the movement of the maximum is inconsiderable. The curves shown in Fig. 13 are taken from the investigation by Crova, who has determined the distribution of luminosities in the spectrum of sunlight, and of the flame of a petroleum lamp. The maximum in sunlight is at λ = [illegible], that of the petroleum $\lambda = 592$. Nearly all sources of illumination will be found to have a maximum lying between these two wave lengths.

A comparison of the total luminosity of the incandescent lamp with its candle power shows that the former increases with the energy of the lamp more rapidly than the latter, although the discrepancy is not so marked as in the comparison of efficiency of candle power with that of luminous radiation.

The following table, obtained by the summation of the luminosity curves, shows the relation between candle power and [illegible] luminosity, [illegible] by Schumann.

[illegible]

Candle power and total luminosity [illegible] lamp.

Watts	Candle power	Total luminosity
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	18.80	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

[illegible] candle power does not [illegible] either of the light-giving energy or of the luminosity [illegible] source of illumination. When used in the comparison of sources which differ in temperature, the indications of the photometer always yield us relatively too low a value for the intensity of the lamp of higher incandescence. In the case of [illegible] gas, or either of these in comparison with the incandescent lamp at normal temperature, the error is not important, but between the candle and the "16-candle" lamp maintained at 50 candle power, the discrepancy amounts to 10 per cent. For the electric arc the ratio of candle power to total luminosity is very nearly 4 : 5, and in the case of daylight it is about 4 : 6.

In arc light photometry candle power is already a well-nigh meaningless term. Would it not be well to abandon it altogether in favor of some standard affording us an expression for the luminosity of radiation? So far as the incandescent lamp is concerned light-giving power is a perfectly definite function of the temperature, and of the area of the radiating surface. We are unfortunately not in position at the present day to measure the temperature of an incandescent filament, but the time will undoubtedly come when the relation between the temperature and the quality of the light emitted by glowing carbon will be definitely known. We may, indeed, look forward to the development of some optical method for the measurement of the temperature of incandescence which shall be as easily performed as our present method of determining candle power, and which shall admit of a much higher degree of precison. The comparison of lamps, the temperatures of which are the same, will then reduce itself to a question of radiating surface. Total luminosity and total energy of luminous radiation, per unit of surface, together with net and gross efficiency, may then be expressed, in so far as incandescent carbon is our source of illumination, as functions of the temperature alone, and the performance of any lamp may be defined in terms which admit of no uncertainty.

Meeting of the New York Electrical Society.

At the one hundred and twentieth meeting of the New York Electrical society, held at Clinton Hall on the 20th, the following officers were elected for the ensuing year: President, Francis B. Crocker; vice-presidents, Joseph Wetzler, Francis Forbes and Dr. Otto A. Moses; secretary, G. H. Guy; treasurer, Henry A. Sinclair.

The subject for the evening's discussion was "The Underground Wire Problem in New York City." President Pendleton, who presided, said that the momentous question of the hour in the electrical circles of the city was the underground service for electric lighting, the telegraph and the telephone. The small potential used in the two latter systems would seem to indicate that the difficulties that appear to exist in dealing with high tension might be obviated but the variety of opinion expressed on this subject was bewildering, even to an electrician. It was stated that the experiments made in Chicago had resulted most favorably, but he had just seen a gentleman from Chicago, who said that in that city not a single instance could be pointed out in which the system had been successfully introduced. It was evident to him that the electric light companies in New York were going to be very great sufferers in being obliged to put their wires underground. During the introduction and development of their respective systems, they had been subjected to such expenditure and prices had so run down as to leave them with a very small margin of profit, and now the additional expense of putting the wires underground would entail additional expense. The position taken by the mayor is: "The wires must go underground." The question for the meeting to consider was: 'Can the electric light wires be put underground, and the electric light companies carry on their business?"

C. O. Mailloux said that, judging from what was being done in other cities, and the progress that had been made in the insulation of wires, he was of opinion that the arc light wires could be run underground. "Cannot" was a word that did not find a place in the electrician's dictionary, and the problem before them would unquestionably be solved. He dwelt on the difficulty of perfect insulation, and the way in which, when incipient leakage was entailed by the length of circuit and high electromotive force incidental to arc lighting, the current would produce a disintegrating effect upon the insulating material, and in the course of time very serious leakage would be the result. His experience, however was, that if the very best insulating materials were used, and the conductors were laid in such a manner as the facilities now at the command of electricians enabled them to place wires, the work would stand for a long time. Mr. Mailloux made some interesting remarks on maximum insulating resistance, and showed what good results can be gained by strict attention to detail and by the use of good material. Unfortunately there was no system where there was such a tendency to slipshod work as in arc lighting in this country. Foreigners had frequently remarked this and in the majority of instances that had been quoted by them, the criticism was a just one. He believed that if the same care were bestowed on the installation of the arc lamp that is bestowed on the [illegible]

[illegible]

responding increase took place in the Twenty-fourth street cable. This result encouraged the belief that the action of the [illegible] in drying out the internal moisture in the joints.

Mr. Cuttriss referred to [illegible] in Broadway, and said that no insulation could remain intact in a temperature of [illegible] degrees, [illegible] assured was the actual heat at one time. He [illegible] getting the best of insulation and the best of joints, and from the results of the five years' working of underground wires by the Commercial Cable company, he strongly recommended the use of gutta percha. The first cost might be excessive, but in twenty years the policy would prove itself a wise one. Mr. Cuttriss agreed with Mr. Wetzler in regarding the commercial success of arc systems run on the proposed lines as very doubtful for the expense incurred in rentals, etc., by large companies would be enormous.

Mr. Wheeler admitted that, though the first cost of a thoroughly efficient arc subway system might be great, the security and preservation of the cables would be insured to the company for a long period, and the profit would be greater in the end.

Judge Coxe's Decision in the Storage Battery Suit.

The Electrical Accumulator company of New York, and the Julien Electric company of New York, hold decidedly different opinions in reference to Judge Coxe's decision in the suit in which the former company was plaintiff and the latter defendant. The interpretations are so greatly at variance that quotations from communications received from them, are of interest. The Electrical Accumulator company writes: "Judge Coxe has just rendered a decision in the United States Circuit court for the southern district of New York sustaining the Faure patent for improvements in secondary batteries or accumulators. The patent is held to cover and control the manufacture, use or sale of any secondary battery in which an electrode is used having the so called active material applied in the form of a paint, paste or cement, which is the only method yet known of constructing a practically operative secondary battery. The suit is entitled the Electrical Accumulator company *vs.* Julien Electric company, and the complainant is entitled to an injunction, which will now be taken. With the exception of the recent decision of the United States court for the district of Massachusetts, sustaining the Thomson-Houston patent for an arc light current regulating device, the Faure patent above alluded to is the only electrical apparatus patent pertaining to lighting or motor business, the litigation on which has terminated favorably to the claims of the patentees."

The Julien Electric company writes: "The Electrical Accumulator company sued the defendant on four patents. One patent the complainant abandoned during the trial; two others are decided to be invalid. Two claims only of the fourth patent were in controversy. One of the claims, it was held, the defendant does not infringe; the other claim, the court holds, is invalid as it stands, and can only be sustained when limited by a disclaimer to a [illegible] which the defendant does not use. The decision is a substantial victory for the Julien Electric company."

Gaulard & Gibbs' Patent Case.

Lord Justice Lindley of the Court of Appeals of England handed down his decision in the [illegible] transformer patent case at London March [illegible]. After exhaustively reviewing the case, the [illegible]

"[illegible] Although some of the specifications [illegible] patents came very near the patentee's invention [illegible] them quite came up to it. [illegible] combination of [illegible] an electro-dynamo [illegible] alternating currents of high tension [illegible] induction coils, specially constructed, [illegible] intervals for producing light [illegible] The patentees' system is essentially that [illegible] was new apart from the special [illegible] Nothing [illegible] specially constructed generators on which the patentees [illegible] as much stress, [illegible] their special features [illegible] having [illegible] the [illegible] shown in the drawings, [illegible] instruction, so that an induction coil [illegible] purpose without departing [illegible] the [illegible]

[17] C. Vierordt, *Annalen der Physik und Chemie*, B. [illegible], p. [illegible]

[18] Mace de Lepinay and W. Nicati, *Journal de Physique*, second line, [illegible], p. 75, 1883.

[19] Otto Schumann, *Elektrotechnische Zeitschrift*, Bd. [illegible], p. [illegible]

[illegible] particularly described [illegible] bring it into effect [illegible] competent electrician who seizes the idea to give effect to it, notwith-[illegible] It is not necessary for us to decide whether the patentees could or [illegible] their system, [illegible] Perhaps they [illegible] was not their intention, as originally described. They have so over-[illegible] constructed generators, and have so drawn and altered their specifications, as to have missed their mark. As already stated, their special form of generator was originally made an essential feature [illegible] mistake. They have tried to correct it by amending their complete specification, but in doing so they have entirely changed their front and the nature of their claim. To understand the effect of this amendment it is necessary to see what the patentees have done, and what they now claim, by their amended specification, to be the invention for which they have obtained their patent. The amended specification is vague and ambiguous on this very important point. If confined to a combination of dynamos giving alternating currents of high tension with a main wire, and one of the two induction coils specially described, the patent will be of little or no use to the patentees; whereas, if construed more extensively, as [illegible] such a dynamo with any induction coil having the properties of the two described, the patent will be of immense practical value, for the evidence shows that any coil which any one would be likely to make, would have such properties. The second of these two constructions is, therefore, obviously that which will be most beneficial to the patentees. It is the construction which the patentees have labored to maintain, and the whole of their evidence was addressed to this. No serious attempt was made to show that there was any merit in the two specially described generators except their movable iron wire cores, which almost all induction coils had in 1882. We are satisfied that no other construction is worth contending for, and it is, in our opinion, the true construction of the specification as amended. The specially constructed generators are no longer claimed, either separately or as essential parts of the combination. They are seen to have no particular value, and are dropped accordingly. This construction of the amended specification renders the patent hopelessly bad in law; for first, on this construction the invention is not the same as that described in the provisional specification, but an entirely different invention; and, secondly, on this construction the amendment of the specification has greatly extended the scope of the patent. As already shown, the essence of the invention, as described in the complete specification in its original shape, and as set forth in the provisional specification, lay in the use of a specially constructed generator (or combination) which the patentees believed to be superior to all others; and if they throw this over they so far depart from their invention, as described in these documents, as to render the patent they have obtained for it worthless, and incapable of being supported. The law upon this point is perfectly well settled, and it is useless to refer to authority for it. This view of the case renders it unnecessary to consider whether the patent could be supported if it were construed narrowly, and confined to a combination for an alternating dynamo with induction coils constructed like one of the two described in the specification. This point was not much argued. The decision in favor of the patentees would be of little use to them, and the petitioners do not [illegible] as they say they do not use that particular combination. This point, if it fairly arose, would, we think, be found full of difficulty, considering the evidence given at the trial. But having regard to the terms of the specification, and the real contest between the parties, [illegible] In our opinion the patent is bad, and the appeal must be dismissed with costs."

CORRESPONDENCE.

New York Notes.

[illegible] March [illegible] Rapid transit is the chief topic [illegible] prominent men are [illegible] should have some [illegible] It is interesting [illegible] Sage, and in Mr [illegible] rapid [illegible] manner [illegible]

[illegible]

[illegible] track express trains could be run at the rate of 25 miles an hour, and not interfere at all with the present regular train service.

Mayor Grant [illegible] well-founded exceptions to the scheme of Mr. Gould, and says that in order to increase the terminal facilities of the elevated roads a portion of the parks would necessarily be involved, and that he is not in favor of spoiling the public parks with elevated structures. He also thinks that the elevated system is not permanent, and that the settlement of a matter of so great importance should be permanent and in the interests of the great public. There will be a decision soon, but Mayor Grant thinks that there is some influence at work to defeat the Rapid Transit bill which has been lately taken from the committee on cities and referred to the committee on railroads. Is it not time that some of the electrical people take hold of this great matter and devise a scheme of rapid transit which shall be permanent, comfortable, and in the interests of the great traveling public? New York ought to have the great electric railway of the world.

There are all sorts of rumors afloat in connection with the contest for supremacy which is being waged between the big electric light manufacturing companies. One of the latest is to the effect that the great Villard scheme, which was to consolidate all the Edison electric light companies into one immense concern, has fallen through. The report is causing a good deal of talk among electrical men, but is emphatically denied by the Edison people, who say that the consolidation of the different Edison electric manufacturing interests is about completed.

At the meeting of the Board of Electrical Control the 19th inst. the mayor would listen to nothing that was not in the line of progress toward burying the wires. All sorts of pretexts were presented in support of applications for construction overhead, but the mayor said that it was only a waste of time to read applications for such permits. He is decided in the matter, and orders are being given for construction of subways in many of the streets, and also for the immediate removal of poles from some of the streets. For the present New Yorkers are going back to the old way of lighting the streets, and are appreciating the value of the electric light as never before. Necessity is teaching them, and the temporary absence of the beautiful electric light on many of the streets in the end will be a benefit rather than a detriment, for it will surely cure any of the existing dislike to the electric light.

The Julien Electric company and the New York Accumulator company are again brought into prominence through the decision of Judge Coxe. All this litigation in the electrical field must produce its effect. It is undoubtedly a stimulus to its greater development and application.

W. H. T.

Denver, Col.

DENVER, Col., March 23.—The South Denver Electric company last week elected S. V. Farnum president; J. L. Dailey, vice-president; C. L. McIntosh, treasurer, and Joseph Johnson, secretary.

The county commissioners have granted a franchise to Milo A. Smith and John Miller for a street railroad, to be operated with electricity by the means of storage batteries. It is understood that these gentlemen will transfer their franchise to the Eastern Capitol Hill Railroad company as soon as organized. Cars are to be running within ninety days. The proposed route is from the cable road to Superior street, where it will stop for the present.

The Pueblo, Col., Rapid Transit & Circle Railroad company, with William Cook, James B. Orman, L. E. Moses, A. E. Graham and William A. Moses as incorporators, has taken out a charter. The capital stock is fixed at $100,000, and the term of the corporation at fifty years. The motive power has not yet been decided upon, but the incorporators favor electricity.

The Antonito, Col., Coal, Light & Water company, for [illegible] gas, electric lights and [illegible] has been incorporated with capital stock of $3,000[illegible]

E.

Omaha, Neb.

[illegible] Neb., March [illegible] The Omaha Motor company [illegible] track and machinery [illegible] twenty-six cars, the [illegible] the electric system, [illegible] be built of the [illegible] grades. The contract [illegible] at Nicholas [illegible] feet square [illegible] main building [illegible] machinery except for [illegible] The one-story portion [illegible] company intends to [illegible] to house the cars that make the last trips over night. Dr. Mercer, who is the head of the company, said if the company had good weather it would start by June, and operate ten miles of road. The company is filling up small gaps in its system on the north side, and next week will finish the Burt street line. It will then double-track Burt street from Seventeenth to Twenty-second, and Twenty-second north from Burt to the power house at Nicholas street. The southern system will not be in shape until a later date, and the line to South Omaha depends upon the grading of Twenty-fourth street and the action of the South Omaha authorities.

The motor company claims the right under a decision of the court to use the horse car tracks jointly to Sixteenth and Leavenworth, but the litigation over this is not ended. At an early date a 40-horse power motor will be bought for sweeping the tracks.

John Grant, who is in New York on business connected with his subway patent, writes that the Western Union telegraph people are very favorably impressed with his patent, and anxious that he shall secure a franchise, so that it can be used in this city.

C.

Indianapolis, Ind.

INDIANAPOLIS, Ind., March 22.—The Central Union Telephone company has notified its patrons that the local coupon ticket toll system will be abandoned in this city April 1st. Agents of the company are now calling on those having telephones with rental contracts. There are about 900 telephones in use at present. The exchange is prepared to accommodate 1,200 subscribers.

The local Brush Electric Lighting company has been recently putting in incandescent lights where customers preferred them, supplying them from the arc circuits. This, it seems, is in direct violation of a city ordinance, which says incandescent lights shall only be furnished on independent circuits. There was no penalty provided in case of violation. At Monday night's session of the city council a resolution was passed "that no money be paid said Brush company for and on account of electric light furnished to this city under its present contract with the city so long as said company fails to comply with the terms and provisions of said ordinance." An amendment to the ordinance in question was introduced and passed, providing a penalty of $100 for violation thereof.

The Dudley Street Railway company has come to the surface again. T. L. Johnson, formerly owner of the Citizens' Street Railway company, is now at the head of affairs. A report says he owns 4,500 shares of the stock, and the Thomson-Houston Electric company 500 shares. The company expresses a determination to go ahead and put in an electrical road, provided the city amends the present ordinance.

M.

Wichita, Kan.

WICHITA, Kan., March 23.—An ordinance permitting the Wichita & Suburban Railway company to put up wires and poles in the streets of Wichita was passed at the last meeting of the council. An ordinance was adopted granting to the Central Avenue & Eastern Motor line company the right to place wires and poles on the streets for propelling the cars by electricity.

An ordinance authorizing the Wichita & Valley Center Railroad company to place upon the streets and alleys of the city wires and poles for operating cars, was placed upon its passage.

W. L. R. Emmett of the Sprague company of New York city is in the city ready to commence work on the construction of a line for the Wichita & Suburban. The cost will be about $4,000 per mile, and the company contemplates putting in seven and one-half miles. It is also expected to complete the circuit in due time by returning over the line of the Central Avenue company.

D.

Stillwater, Minn.

STILLWATER, Minn., Mar. 20.—An electric street railway system is now an assured fact for Stillwater. A syndicate, including Iowa capitalists and local business men, has been negotiating for a franchise in this city. The council finally passed the required ordinance, and work will be commenced at once. This is gratifying to the people of Stillwater, as heretofore the city has lacked conveniences of this kind. The grades between the business and residence portions of the city are too steep for horse traction, and steam motors would not be tolerated. Those who did not own private conveyances were obliged to climb the hills on foot. Electric propulsion will relieve the latter class by affording a cheap and rapid medium of travel between the business and residence portions of the city. The active movers in the enterprise are W. M. Hewitt of Muscatine, Ia., and Dr. W. [illegible] of Davenport, Ia. Mr. Hewitt is an operator of street car lines of experience, and has been inter-

ested in horse car lines in Milwaukee At present he is connected with the electric road of Muscatine, Ia., in conjunction with Dr. Allen Both gentlemen are convinced of the value of electricity as a means of street car propulsion, and consider Stillwater an excellent field. Mr Hewitt guarantees first class construction and equipment It has not yet been decided what system of motors and generators will be adopted, nor has the power plant been selected

B

Duluth, Minn.

DULUTH, Minn., Mar. 22. The Duluth Electric Light & Power company, at a recent meeting, increased the capital stock from $60,000 to $200,000. The old board of directors was retained, except James T. Hale, who was succeeded by Major H. Upham As indicated by the increase of stock, the future policy of the company will be aggressive. The company recently suffered a serious loss in the burning of the Opera house It had secured a contract for 300 lamps, and the necessary wiring was nearly completed. Most of the lamps and appliances were in place, and the converters for the lamps were in the building, Everything was destroyed. The Duluth Electric company has been completing arrangements for the new station. An excellent site has been secured on the lake shore. In securing this property the company obtains a fine stack and a good foundation on which to build the station. A 400 horse power condensing Hamilton-Corliss engine has been purchased. The company is giving satisfaction. Preparations are being made for an immediate increase of the plant by 500 or 1,000 lights. The contract has been awarded the Duluth Electric company for the city lighting. One hundred and fifty lights of 2,000 candle power each will be used, and it is expected that everything will be in place and lights running by April 1st. S.

Lincoln, Neb.

LINCOLN, Neb., Mar. 23.—The Nebraska Telephone company has expended upward of $3,000 in improving the plant in Lincoln during the last year. This money has been put mainly in reconstructing street lines, much of it being caused by the street improvements. The result is that the telephone service is better, and the appearance of the streets has been considerably improved. Lincoln is the center of radiation for the telephone wires of Nebraska. Six distinct lines run out of the city. The first is a direct wire to Omaha, which is used mainly for through business, there being few exchanges on the way. Another wire to Omaha takes a different route, and gives communication with Greenwood, Ashland, and other intermediate towns. One of the first copper wires put up in the state was strung several years ago between Lincoln and Nebraska City, touching Cheney, Bennett, Palmyra, Unadilla and, in fact, all the stations on the railway between the two cities. A southern wire gives connection with Cortland, Beatrice, Blue Springs, Wymore, Fairbury and other towns, the line being about 120 miles in length. The western line runs to Crete, turning south there to Wilber and DeWitt. This will probably be extended to Hastings at an early day. A direct wire to York, by way of Seward, proves a great convenience, and it will be still more useful to the city when it is extended to Grand Island and other important towns in that direction. These six radiating lines make it possible for the business man of Lincoln to communicate personally with customers in fifty seven towns in the State of Nebraska. At Omaha and at Nebraska City direct connection is made with the telephone system of western Iowa, where sixty-six additional towns may be reached. The business of these outside lines increased in 1888 25 per cent. over the preceding year. A marked increase in the business between Lincoln and Omaha has been noticed, especially since so many of the houses of that city have found it necessary to protect their trade in southern Nebraska by putting in branch houses here, or by forming some business connections in this city. There is also a marked increase in the use of the outside lines by the jobbers of the city throughout the year. H

THE ELECTRIC LIGHT.

Martin's Ferry, O , will have electric lights.

Las Vegas, N. M., has a Brush electric light plant

White Bear, Minn , will be illuminated by electricity.

Eldorado, Kan., has an excellent electric light service.

Keokuk has opened its incandescent electric light station.

Walsenburg, Col , is organizing an electric light company.

Poles are being erected in Clinton, Wis., for electric lights.

The Anaconda mine, Mont., is illuminated by incandescent lights. At first 500 were introduced, and at present nearly [illegible] are operated The plant is [illegible] at $20,000

Searcy, Ark [illegible] organized a local company to [illegible] an electric light

The Marietta, O electric light plant will be [illegible] within sixty days

Postmaster General Wanamaker has over [illegible] in his Philadelphia store.

The Duluth Electric Light company has purchased a power station for $10,700

The Edison Electric Light company at Little Rock, Ark., is extending its plant.

The Thomson-Houston company will install a plant at Brussels for public lighting.

Nevada City, Cal , will have two electric light companies, an incandescent and arc.

The Peru, Ind , council has contracted for thirty-five electric lights at $75 per light.

An incandescent plant will be introduced into the capitol of Wisconsin It will cost $14,500

The Toledo, O., Electric Light company has decided to increase its capital stock to $200,000.

The Texas legislature has appropriated $35,000 for an electric light plant for the new capitol building.

The Savey Electric company of Lima, O , will build a large factory in that city in the next few months.

The Saginaw, Mich , Electric Light & Power company will add an incandescent system to its installation.

The Thomson-Houston company has been granted permission to erect an electric light plant in Griffin, Ga.

Experiments are in progress at Antwerp and Ostend to test the practicability of using electricity in sea fishing.

The Seattle, Wash. Ter., Electric Light company has offered to furnish the city electric light plant for $29,900.

The Metropolitan Museum of Arts, New York. will be lighted by electricity. An Edison plant is being installed

An electric light company has been organized at Lake City, Col , and work will be begun on the plant immediately.

It is proposed to light all the public institutions at Columbus, O., by electricity. The state will probably establish its own plant.

Town Talk, Nevada county, Col., will be lighted by electricity. All the mills and mines in the vicinity will be furnished light by the same company.

The Victoria, B C. Water, Gas & Electric Light company has applied for a franchise to establish water works, gas and electric light plant at Whatcom, W. T.

The South Omaha Electric Light company has contracted with the Westinghouse company for a complete incandescent system, to be in operation in sixty days.

Los Angeles is to have a new electric light and power system. There will be furnished arc and incandescent lights and motors, operated from a central power station.

The Brush Electric Light & Power company of Cleveland recently enlarged its plant, and was backed in the enterprise by the Brush Electric company, to the extent of $19,500

The machinery, engines, dynamos and wires for the Duluth Electric Light company's plant are being placed in position. The installation will be ready for operation within a few days.

The Springfield, Ill., Electric Light & Power company, capital stock $100,000, has been incorporated to furnish electric light power and for the manufacture of electric machinery; incorporators, A. L. Ide, G. N. Black and S. D. Scholes.

An addition of 120 electric lights has been made at the houses of parliament in London, the total number now being 620. The new lamps have been distributed in the reporters' waiting rooms and the members' entrance lobby, staircase and corridor. A further extension of the electric lighting will be made after Easter.

A telegram from Los Angeles says: A special train containing the electric plant for the cruiser Charleston passed through here to-night. Passenger time will be made over the Southern Pacific route to San Francisco. Orders were received at New Orleans from headquarters to use all possible dispatch in the conveyance of the goods on their arrival from New York.

Negotiations for the consolidation of the electric lighting interests of Providence, R. I., are practically concluded. The Narragansett company will absorb the Rhode Island company, issuing stock in payment for the plant of the smaller concern. The Narragansett company is now building a large station. It uses Thomson-Houston arc lights and Westinghouse alternating system for incandescent service.

The large establishment of James B. Clow & Son, corner of Lake and Franklin streets, Chicago, has been furnished with a 200 lamp incandescent plant, of the new Thone system manufactured by the Hawkeye Electric Manufacturing company of Davenport, Iowa. The plant was installed by W. M. Talcott, of Chicago. The dynamo is automatic in regulation, and any number of the lamps may be switched on or off at will. Mr Talcott has also installed a motor in the general offices of the Springfield Fire and Marine Insurance company, at 115 La Salle street, and has orders for several more motors, and two [illegible] orders.

[illegible]

[illegible]

The Kansas City [illegible] The [illegible] Edison and the Sperry Electric Light companies [illegible] expend $100,000 in improvements and extensions during the coming twelve months. The Edison will soon begin operations in their own quarters on Wall street with a station power of 5,000 lights The alternating current system for the purpose of lighting residences will be introduced within six months From [illegible] given employment. The American Electric Light company and the Inter State Electric company [illegible] improvements and extensions contemplated.

Among the recent sales of the Western Electric company, Chicago, are the following: C. W. Pardridge & Co. Boston Store, Chicago, two 45 arc light low tension dynamos, sixty double service lamps, one 150 light incandescent outfit. Liggett & Myer building, St. Louis, Mo., four 50 light high tension dynamos, 200 single lamps, two 75 light incandescent dynamos; also steam plant complete. Aberdeen Light & Power company, Aberdeen, Dak., one 3[illegible] arc light high tension outfit. Economy Steam Heat company, St. Paul, Minn., one 50 arc light high tension outfit. City of Galveston, Tex., six 35 light low tension dynamos, with 175 double service lamps for street lighting and the steam outfit complete.

A correspondent at Winterthur, Switzerland, writes: "Although it is constantly said that the existing gas works have in nowise suffered by the introduction of the electric light, yet the manufacturers of gas apparatus are complaining of scarcity of orders, there being hardly any new gas works now erected in Switzerland. It is easily understood that the electric light would be preferred to gas in such situations where water power is abundant; but the experience of the last year or two shows that the electric light is cheaper than gaslight, even in such cases where the power has to be obtained from steam engines, and hence large manufacturers who have not already a gas supply prefer to put up an electric light installation instead of a local gas plant."

THE ELECTRIC MOTOR.

Green Bay, Wis , will have an electric railway this summer.

Nashville, Tenn., will have an electric railroad in operation May 1st.

Portland, Me., will construct an electric railway at an expense of $75,000.

David Robinson has secured the franchise for an electric railway in Toledo, O.

The Royal Electric company is operating the Home flouring mills at Peoria by electricity.

Negotiations have been completed for the construction of an electric railway between LaCrosse and Onalosha.

It is possible that the Omaha & Council Bluffs Electric railway may be extended from Council Bluffs to the Chautauqua grounds.

The Omaha Electric Railway company has been granted permission to extend its tracks. It will operate open cars during the summer months

Work has been begun on the electric railway plant at Salt Lake city. Ten cars will be operated May 15th. The power station will be arranged for two 250 horse power dynamos.

Decatur, Ill., is establishing an electric railway. The contracts for the power house, car shop, and the ties and steel rails have been placed. The road will be running, according to contract, by July 1st.

The Westinghouse Electric company has stretched the wire for the test electric railway, which has been constructed in Pittsburgh to demonstrate the efficiency of the Tessla motor for operating railways.

The Chicago syndicate that recently purchased the Indianapolis Street Railway line is endeavoring to secure an extension of its charter, which expires in about twelve years, for half a century, and the general manager has promised to put in an electric railway line at an expense of $75,000 as an experiment if the charter is granted.

The [illegible] Manufacturing company of Brooklyn have made the following recent sales: ½ horse power motor to the Physical laboratory of the University of Michigan, Ann Arbor, Mich; two 1/6 horse power motors to Stephen D. Field, two ½ horse power and two 1/6 horse power motors to Thomas A. Edison. These machines will be used to drive working models and light machinery in the large exhibit which Mr Edison will make at the Paris exposition

two 1/8 horse power motors to the Postal Telegraph company, [illegible] Chicago and one in New York city [illegible] of the American Machine Telegraph system; one horse power motor to the Western Electric company, Chicago, Ill.

The South Denver, Colo., Electric company has elected [illegible] president, [illegible] vice-president, [illegible] L. McIntosh, treasurer, and Joseph Johnson, secretary. The electric company, under its franchise, will have the right of way for four miles, and over half the needed subsidy is already pledged. The line will be lighted by electricity.

[illegible] president of the Highland Park Railway company of Detroit, has written a letter to the Woodward Electrical company testifying to the efficiency of the Detroit storage battery. He says: "The car Ampere, belonging to this company, which is equipped with eighty-four [illegible] manufactured by the Detroit [illegible] was yesterday put upon our road for the purpose of ascertaining the amount of service to be obtained therefrom. The distance covered by the [illegible] trips, was over 100 miles, and the average rate of speed was twelve miles per hour. The number of passengers carried was 456 and [illegible] current was furnished by the battery [illegible] two [illegible] candle power incandescent [illegible] half hours. The [illegible] at night, and [illegible] passengers on a [illegible] the slightest [illegible]

During the last week the Sprague Electric Railway & Motor company of New York have closed several important contracts in railway work. One of these is with the Marlborough, Mass., Street Railway company. Part of this is double track, part single. The contract calls for the regular Sprague overhead system and latest type of motors. Another contract closed by the Sprague company for street railway equipment is in Wichita, Kan., where seven and a half miles and four cars will soon be running by electricity upon this system. The improved 15 horse power motors will be used. Another street railway to adopt electricity as a motive power for their cars is the railway company of Eau Claire, Wis. This contract calls for the furnishing of six cars over five miles of track. The regular Sprague overhead system will be used, with a small No. 6 wire as a working conductor. The president and managers of this road visited a number of electric railways in operation in the east and other parts of the country. As a result the decision was unanimously in favor of electricity.

THE TELEPHONE.

Griffin, Ga., is establishing a telephone exchange.

The Seattle, W. T., telephone system is being rebuilt.

Evansville, Ind., has been connected with Mt. Vernon by telephone.

An effort to connect Raleigh and Durham, Va., by telephone promises to be successful.

The Iowa Union Telephone company has elected the following directors: Arthur G. Fuller, George Albree, James Thompson, F. H. Griggs, James T. Lane, E. E. Cook, A. Burdick and A. L. Cutter. The company has 5,000 miles of wire in operation in the state.

The Highland Improvement company of Helena, Ark., is negotiating with Manager Fowler of the Erie Telegraph & Telephone company, for the erection of lines between that city and Memphis, and Friar's Point and Grenada, Miss. The Mississippi River will be crossed by a cable, and all of western Mississippi and eastern Arkansas will thus be connected by a thorough system of telephone communication. The design is to connect all of the towns along the line of the [illegible] New Orleans & Texas railway in Mississippi, and along the lines of the Arkansas, Midland & St. Louis, Iron Mountain & Southern railway in Arkansas, both with Helena and Memphis.

THE TELEGRAPH.

[illegible] to assess [illegible] similar to the [illegible] the senate. It [illegible] the enforcement of the [illegible]

The [illegible] from Petersburg [illegible] began [illegible] Western Railroad [illegible]

[illegible]

[illegible] train and [illegible]

had grown uneasy, and telegraphed her husband. This telegram likewise was not delivered for several hours. The uneasiness and suspense occasioned by these delays, it is alleged, has seriously impaired Mrs. Joseph's health, and she brings suit to recover damages.

Miscellaneous Notes.

The general assembly of Ohio has appropriated $10,000 to establish a course of electrical engineering in the Ohio State university.

The formation of the Wauwatosa, Wis., Electric company is announced; capital, $50,000; incorporators, L. R. Godfrey, Henry B. Sporleder, J. H. McBride, E. D. Hoyt, Edward Coulthard, M. J. Fisk and J. S. Wharton.

The following story comes from Boston, Mass.: Ex-Chief of Police Glass of Saugus is an enterprising man, but for once his ambition has gotten him into an embarrassing position. He is the agent for a patent burglar alarm, and he had recently placed one in the house of a prominent resident there. He says a young man of the town advised him to advertise the alarm by trying to break in the house where he had recently placed it, and thus call people's attention to it. He said he knew that the attempt was fraught with danger, but he joined the young fellow in the operation. The young man, it seems, had informed the police, and just as the two burglar alarm testers attempted to spring the alarm the police caught them and carried the ex-chief to the station, where he is now held for trial for burglary.

Personal Paragraphs.

T. P. Conant, of Conant & Hood, western representatives of the Electrical Accumulator company of New York, has just returned to Chicago from an eastern trip.

It was mentioned in a recent issue that C. D. Crandall had resigned as secretary and treasurer of the Missouri & Kansas Telephone company to accept a position with the Western Electric company. On March 15th a dinner in Mr. Crandall's honor was given by a number of his friends in Kansas City.

Business Mention.

The Woodhouse & Rawson company of London has received a first-class award for its exhibit of electrical apparatus at the Melbourne exhibition.

The Western Electric company of Chicago received an award at the Melbourne exposition, Melbourne, Australia, for its exhibit of electric bells, annunciators, etc.

The Electrical Supply company of Chicago will exhibit its numerous specialties at the Paris exposition. Prof. Hering will have charge of the arrangements for the exhibit.

Among the recent sales of the Silvey Electric company were two 4 horse power motors—one to William Bailey & Sons, and another to Robert Parmenter, of Lima, O., the latter to be used in a printing office.

The Electrical Supply company of Chicago is introducing a wire coupling, the invention of Prof. C. Hering. The special feature of this device is that it grips the wire all around and the conductivity is not lessened.

The Automatic Switch company of Baltimore has just issued a pamphlet which describes the Whittingham automatic switch, which is sold by the company. The pamphlet contains considerable valuable information.

The India Rubber and Gutta Percha Insulating company of New York has issued in pamphlet form an article recently printed in a prominent London journal comparing India rubber and gutta percha with other insulating materials. The facts thus presented will prove interesting to those engaged in electric lighting.

"The Sprague Electric Motor for Railway Work" is the title of a neat pamphlet issued by the Sprague company, in which is presented considerable information bearing upon this department of electrical development. In addition to the data a large number of cuts are presented, showing several lines operated by this company.

A circular from Profs. Ayrton and Perry says: "Messrs. J. W. Queen & Co., of Philadelphia, Pa., are alone authorized to sell our electrical measuring instruments in the United States and Mexico, and all instruments sent to America which have satisfactorily passed our tests, will bear the name of them as American agents, as well as being accompanied by our certificate of accuracy."

A company which has substituted the Thomson-Houston carbon [illegible] copper brushes on its railway motors [illegible] The commutator is in good order, and the carbon [illegible] worn [illegible] than 1-32 of an inch after running seven [illegible] of [illegible] hours each. I have another set which is [illegible] Another states: "I have not taken [illegible] of the carbon brushes yet. They have been running [illegible] days in two cars." A later report from the same place states: "I have had one set of carbon [illegible] twenty-seven days, and in that time [illegible] and the brushes are good [illegible] The commutator lasts longer with [illegible] the carbon brush lasts longer than [illegible] says: "On December [illegible] on car No. 11. They [illegible] the commutators. They [illegible] very smooth, glazed [illegible] no oil or other lu[illegible] eighteen hours each, and [illegible] miles." A later one [illegible] December [illegible] I put car [illegible] These brushes worked well, and have same effect upon the commutator as those on car No. 11. They were in use from the 3d inst. to the 20th inst., sixteen days, and making an approximate mileage of 703 miles."

Electrical Patents.

Issued March 19th, 1889.

399,646. Dynamo Electric Machine. Joseph W. Balet, New York, N. Y.

399,666. Telephone Transmitter. Charles A. Hitchcock, North East, Pa.

399,7[illegible]6. Electrically Controlled Hydraulic Elevator. Charles Whittier, Boston, Mass.

The invention consists essentially in a hydraulic elevator system, of a regulator operated by changes in pressure of the fluid used to actuate the elevator, a pump, and an electric motor, combined with a switch controlled by the regulator to affect the circuit of the electric motor to start or stop the pump, according to the pressure of the fluid employed.

399,732. Electric Railway Switch. Edward Blake, Boston, Mass.

399,738. Coupling and Automatic Circuit-Breaker for Fire Alarm Circuits. John J. Cannan, Rochester, N. Y.

A combined breaker and coupling formed by clamping the wires between plates are used; one or both of the plates should be good conductors of electricity. The clamping plates are retained in position by means of a fusible retainer, which will melt at a low temperature.

399,748. Incandescent Electric Lamp Socket. Charles E. Egan, Columbus, O.

The circuit through the filament may be made and broken, and the lamp firmly secured in its socket by simply manipulating the body of the lamp, no key being necessary.

399,755. Electrical Distribution by Secondary Batteries. Frank King, Fulham, County of Middlesex, England.

The last claim is given: "8. In a system of electrical distribution, the combination, with a set or sets of batteries provided with apparatus for automatically charging and discharging the said batteries, of cells used as counter-electromotive force for the regulation of the electromotive force in the discharge circuit of the said batteries."

399,786. Electric Light Support. Benjamin Schardt and George Jones, Dayton, O.

399,800. Dynamo Electric Machine. Elihu Thomson, New Britain, Conn.

The invention consists in the combination with two systems of coils wound over suitable cores and revolving in opposite directions, of a commutator for each system, and a bridge piece of iron for bringing the two systems into close inductive relation.

399,801. Alternate Current Inductor. Elihu Thomson and Merle J. Wightman, Lynn, Mass.

The invention consists essentially in the combination, with an alternating inductor, of a locally applied modifier or retarder of the inductive action applied directly or indirectly to a part of the field of inductive action directly or indirectly set up by said inductor, whereby a lagging of the alternations of inductive action produced by such part behind those of an adjoining part, or parts, will be produced, thus giving the effect of two or more adjoining sets of alternations of induction, differing or displaced (more or less) in phase.

399,822. Electric Blast-Blower. Harry H. Blades, Detroit, Mich.

Claim 3 reads: "In a positive blast-blower, a blower-case an armature of an electric motor eccentrically journaled within said case and having wings adapted to reciprocate through said armature, and mechanism for maintaining said wings in contact with the inner periphery of the blower case."

399,826. Electric Conductor. Alfred A. Brooks, Cambridge, Mass.

399,876. Circuit-Closing Device for Electrical Torpedo Fuses. James W. Graydon, Washington, D. C.

399,879. Electrical Fuse for Ordnance Shells. James W. Graydon, Washington, D. C.

399,950. Friction Gear for Electric Motors. Charles J. Van Depoele, Lynn, Mass.

The motor starts off at full speed; the friction gear, however, causes the car to start gradually without jerking. The invention is covered by eighteen claims, of which the fifth follows:

"The combination, with the separately movable axles, of a car truck and a motor and gearing extending between the armature shaft of the motor and said axles for propelling the same, said gearing including a yielding gear-wheel arranged to accommodate any changes of position in said axles with respect to the gearing."

[illegible] Hinge Joint for Electric Belts. Nicholas Warrell, Farragut, Ia.

400,02[illegible] Electric Alarm Signal for Cables. William H. Woodring and Clarence S. Gilbert, Kansas City, Mo.

Claim 3 is appended: "In combination, a drop constructed to partially surround a cable, and a pivoted guard or finger constructed to rest normally over the cable, the said finger having a bearing against the side of the drop in the direction in which the cable moves when the drop is upright and free to swing on its pivot and release the cable when the drop is tilted."

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The rubber used in insulating our wires and cables is specially chemically prepared, and is *guaranteed to be waterproof*, and *will not deteriorate, oxidize or crack*, and will remain flexible in extreme cold weather and not affected by heat. The insulation is protected from mechanical injury by one or more braids and the whole slicked with Clark's Patent Compound, which is water, oil, acid and, to a very great extent, fire proof. *Our insulation will prove durable when all others fail.* We are prepared to furnish Single Wires of all gauges and diameter of insulation for Telegraph, Telephone and Electric Lights from stock. Cables made to order.

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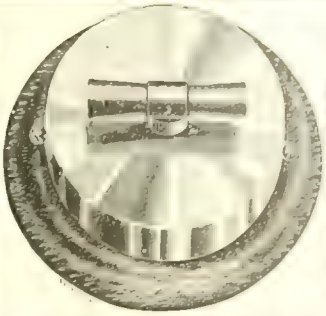
HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.



A DEPARTURE IN

INCANDESCENT SWITCHES

[illegible] make and break movement, [illegible] handle, made entirely of steel, not spring [illegible] the latter not entering into the construction [illegible] imperfect contact caused by [illegible] or dirt, [illegible] will not be affected [illegible] Send for illustrated circular and price list.

H. T. PAISTE,

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NEW YORK CITY:
T. J. Hunter & Co., 27 Church Street.

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Resistance Coils determined with or without temperature co-efficients.
Insulation Resistance of Cables, etc., measured.
Efficiency of Dynamos and Motors determined.
Primary and Secondary Batteries tested.
Curves of Magnetization of Iron and Steel furnished from Samples.
Etc., Etc.

Circulars and Information regarding the Methods Used, Prices, etc., Sent on Application.

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MANUFACTURERS OF

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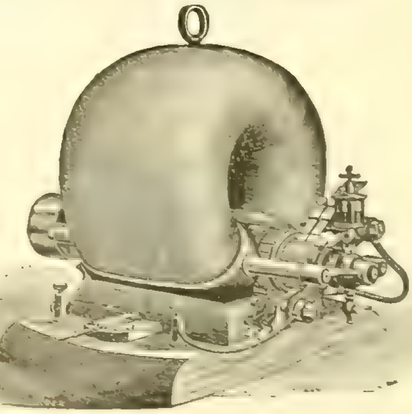

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FOR ELECTROPLATING, ELECTROTYPING, COPPER REFINING, ETC.

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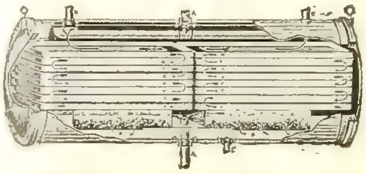

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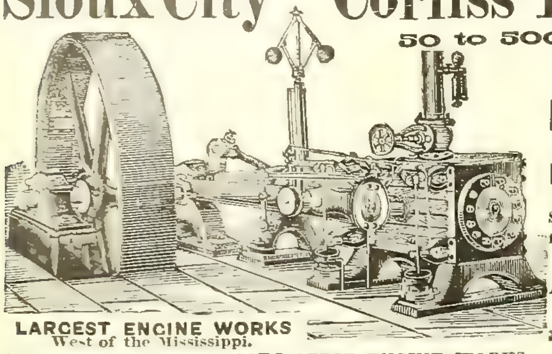

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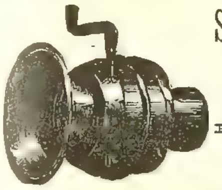

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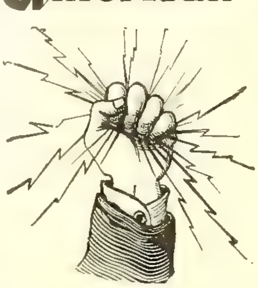

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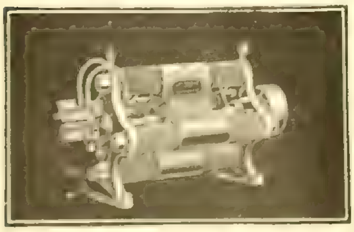

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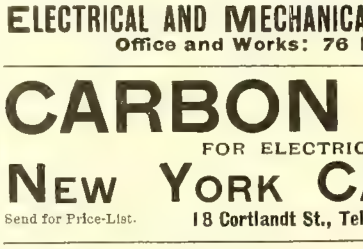

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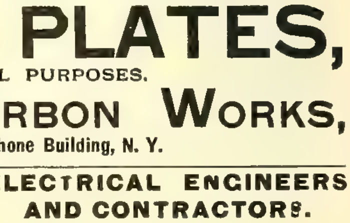

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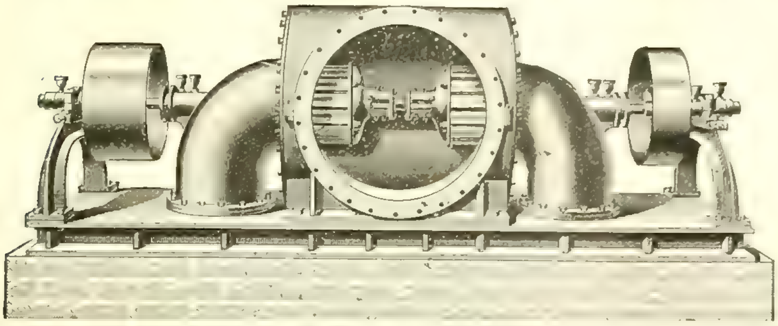

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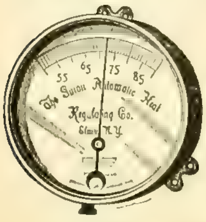

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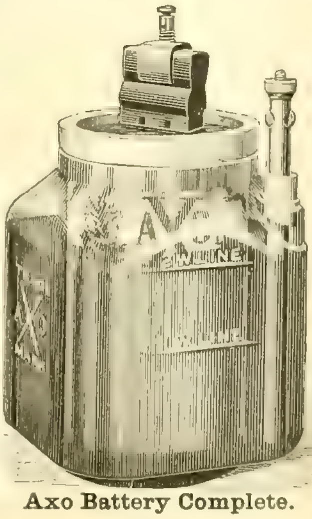

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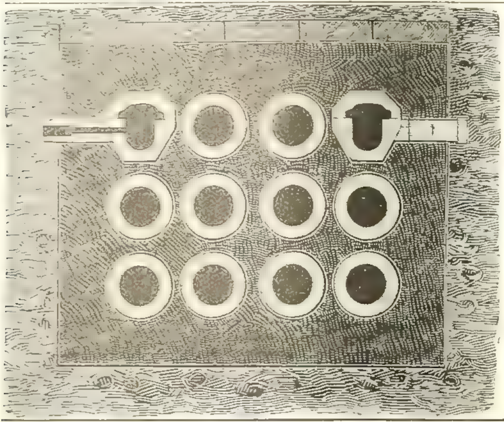

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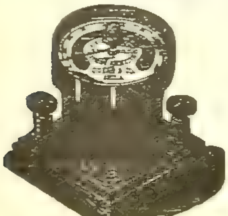

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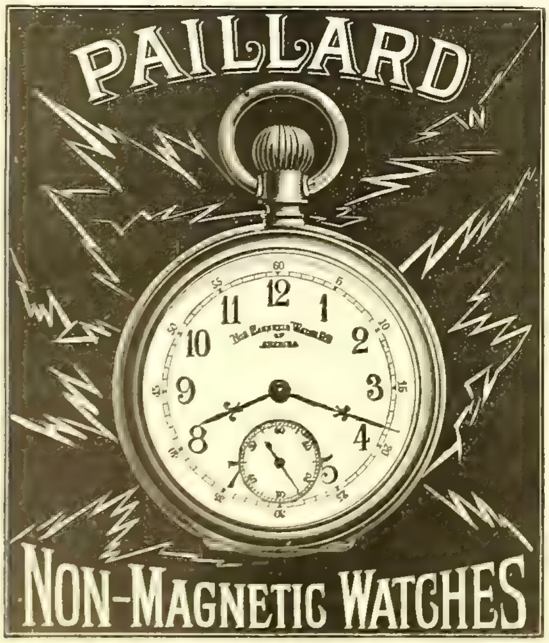

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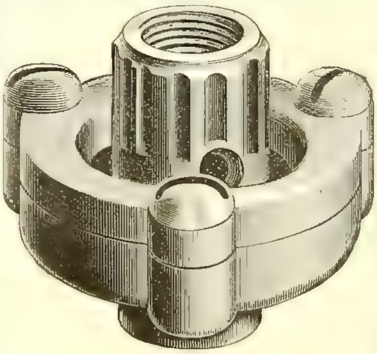

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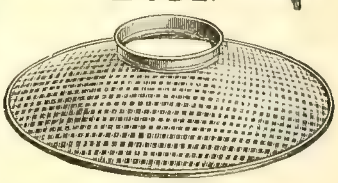

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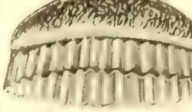

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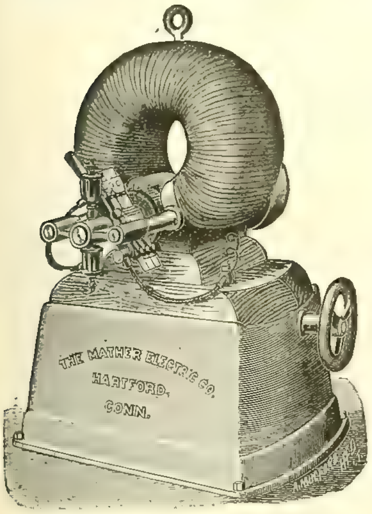

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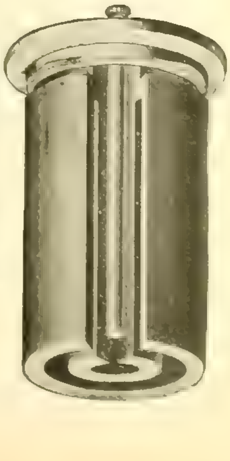

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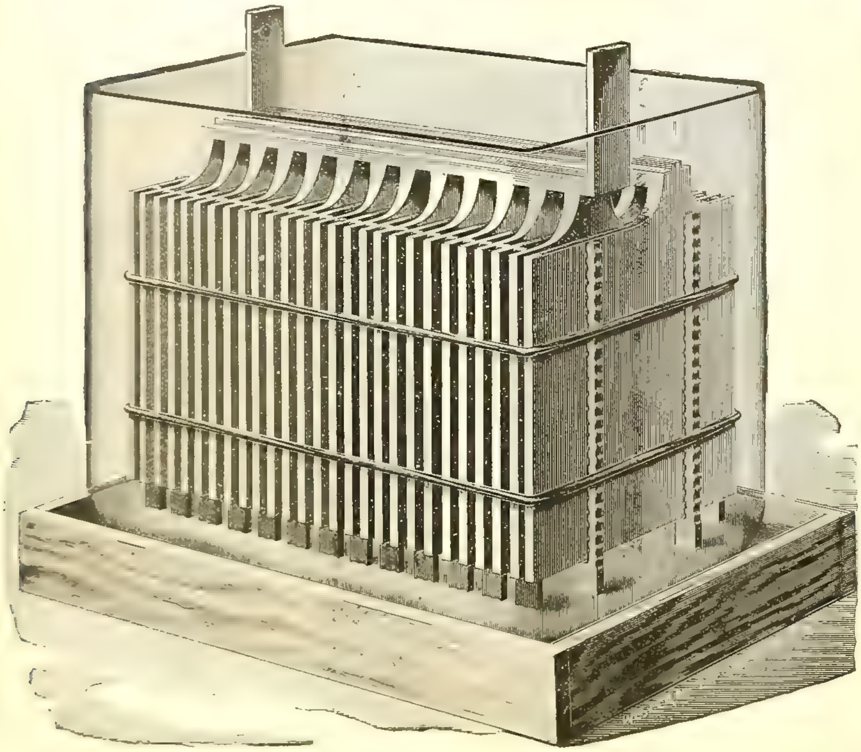

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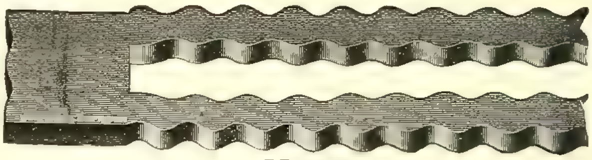

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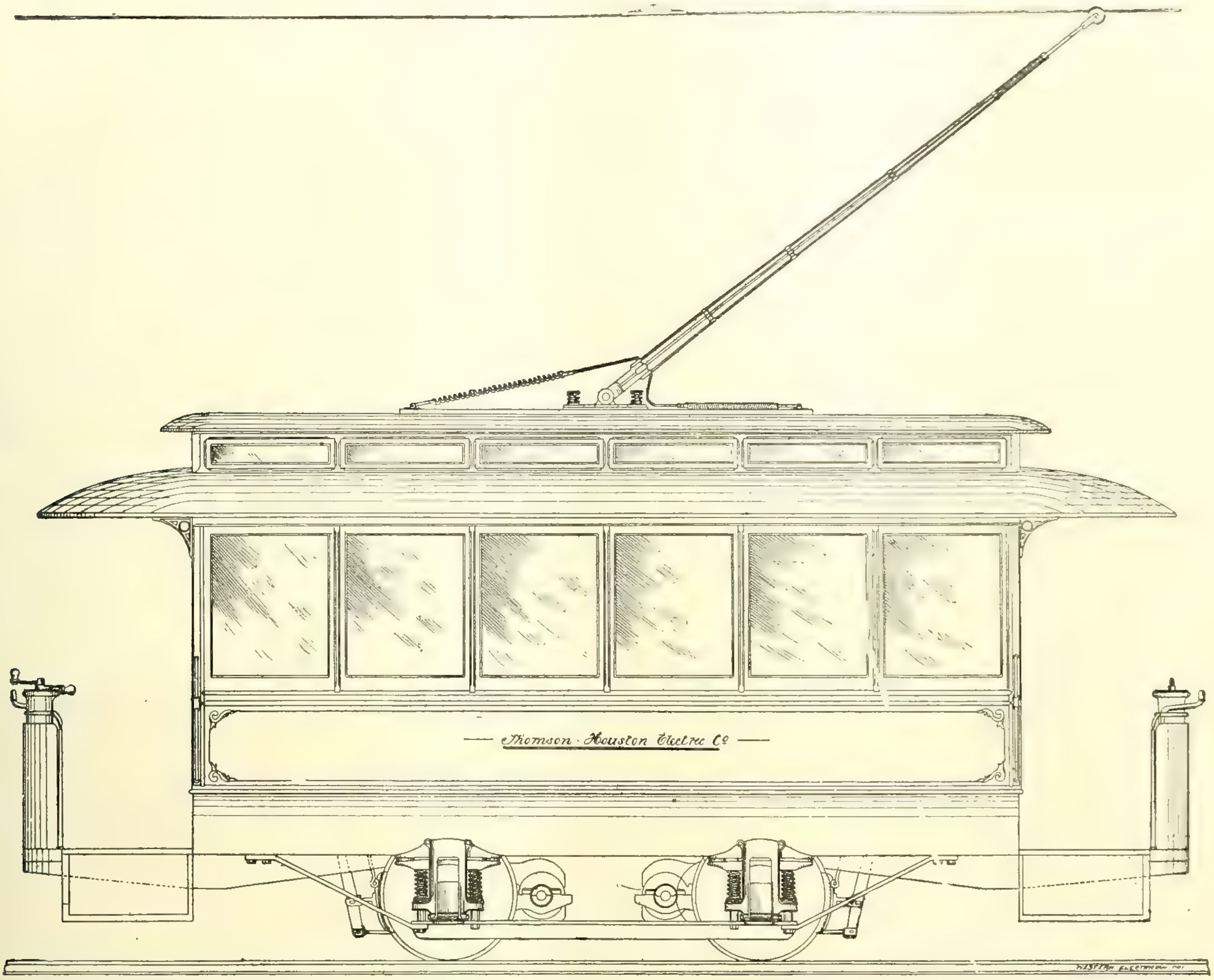

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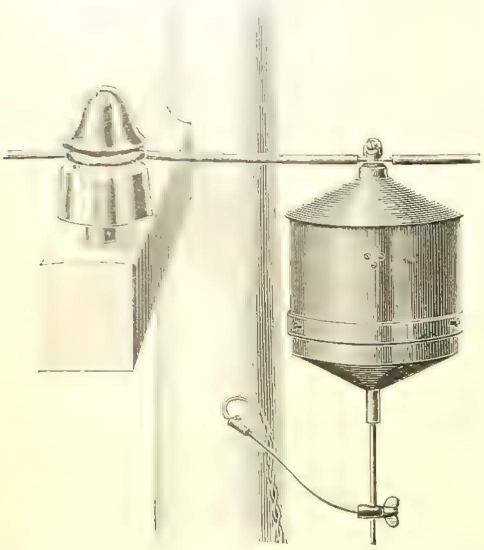
Vulcanite Wires and Cables have higher insulating qualities with lower inductive capacity than any other insulated wires ever produced. The insulation is in no way affected by acids or alkalies, heat or cold, fumes, gases or other vapors, in fact any condition that can possibly exist in and about packing houses, basements, distilleries, malt houses or breweries, or others of a class of most difficult places of installation for electrical conductors.

Automatic Pole Lightning Arrester.



One Arrester will guard one-half mile of circuit and absolutely prevent any damage from lightning. It is self-acting, there is an entire absence of self induction, and it requires no constant consumption of energy to keep it in operation.

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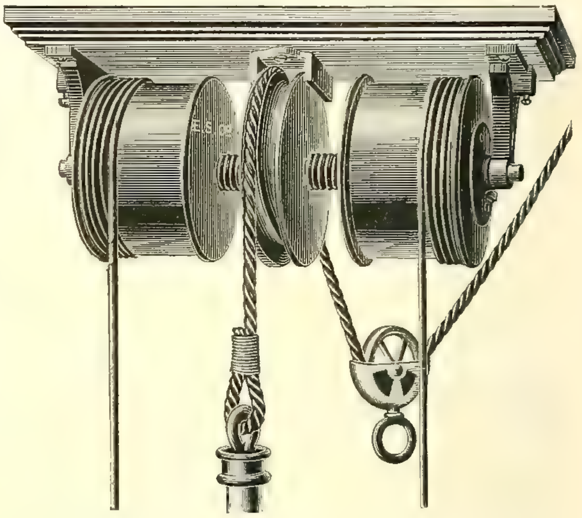

The Lamp is supported independent of the conducting wires, making it impossible for it to fall.

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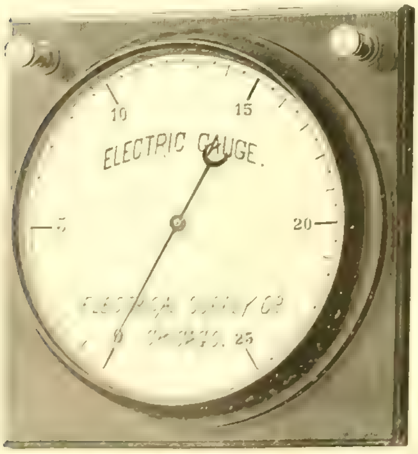

[illegible] amperes. Direct read [illegible] degrees on a dial [illegible] any variation of [illegible] distance.

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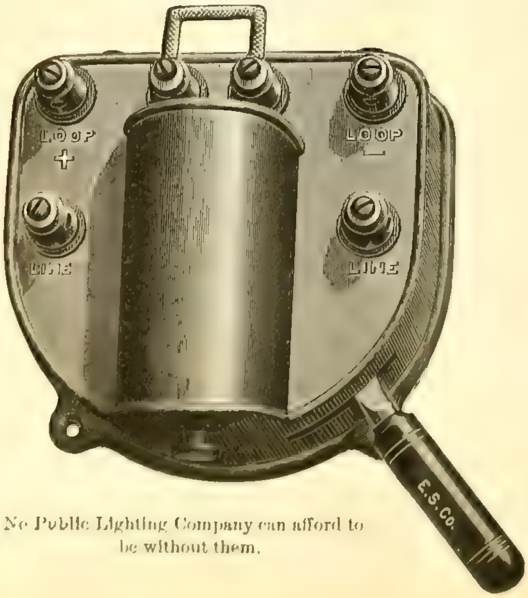

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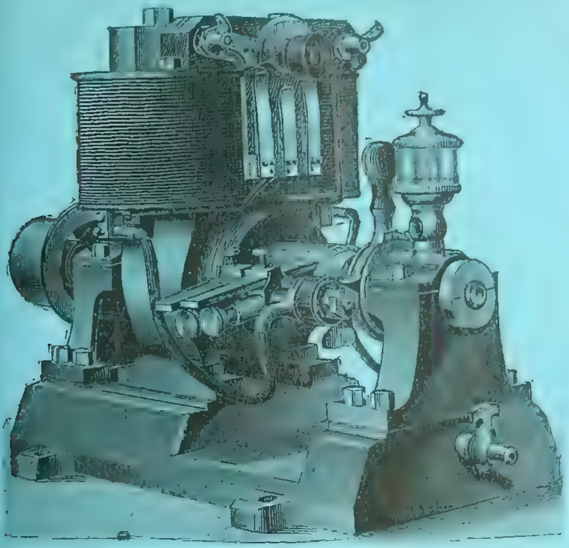

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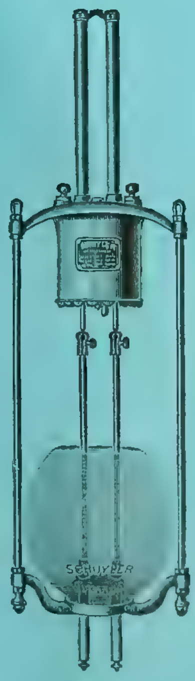

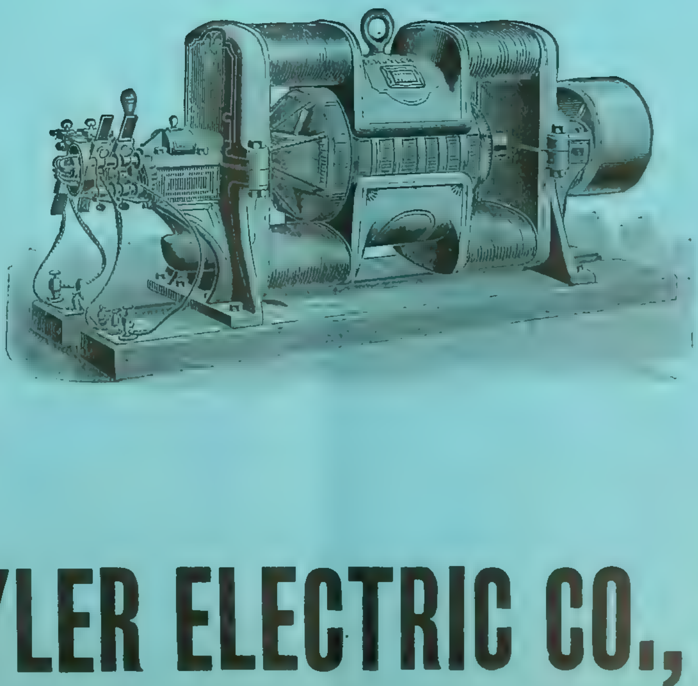

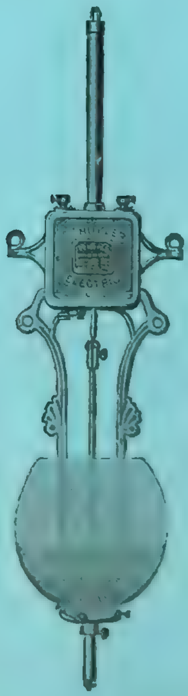

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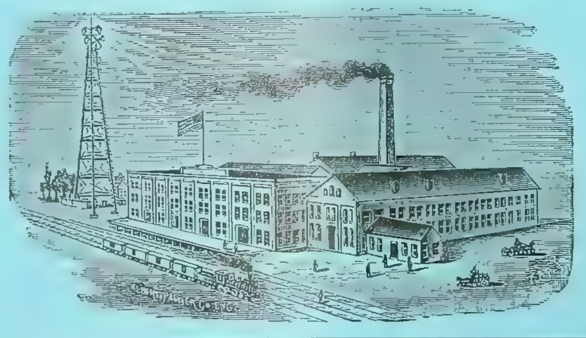

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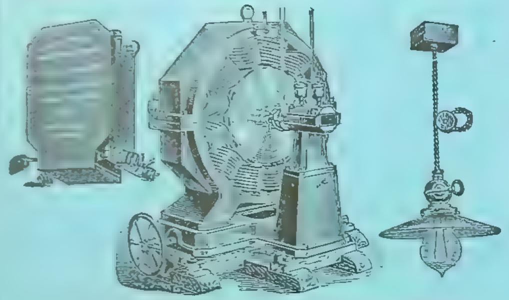

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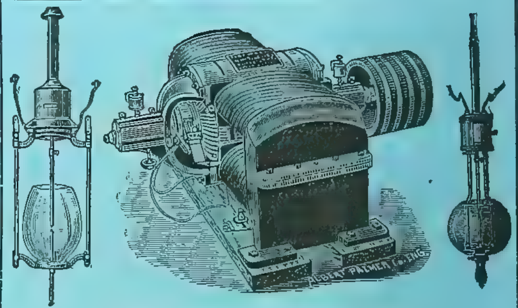

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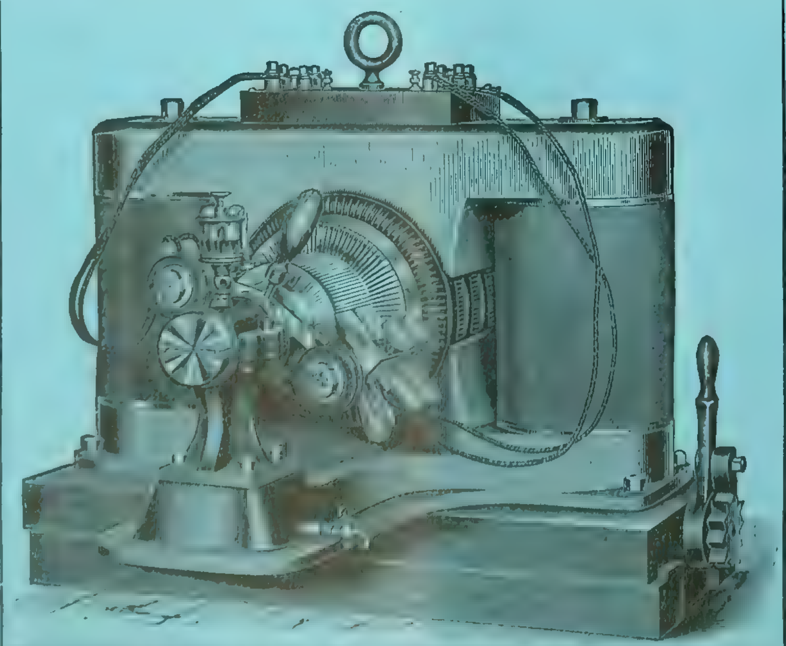

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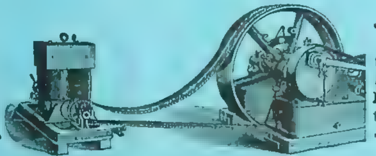

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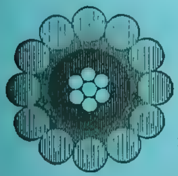

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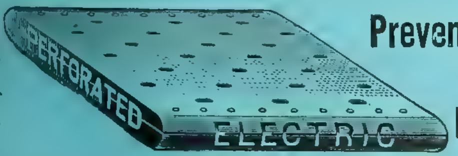

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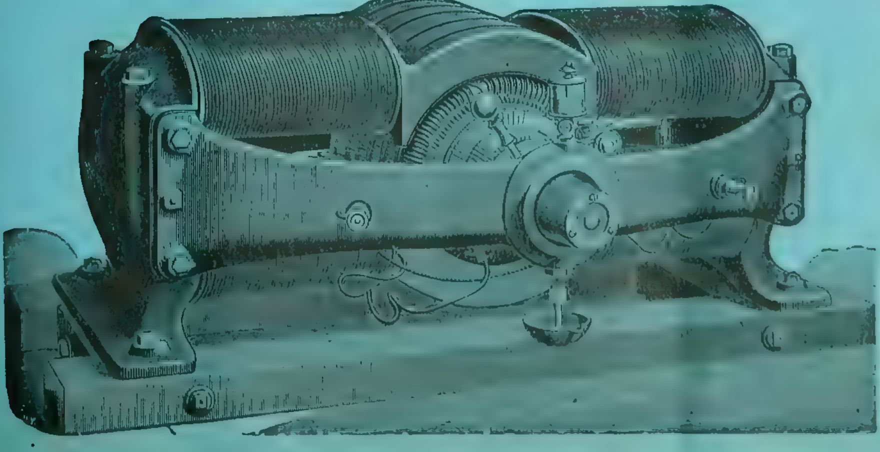

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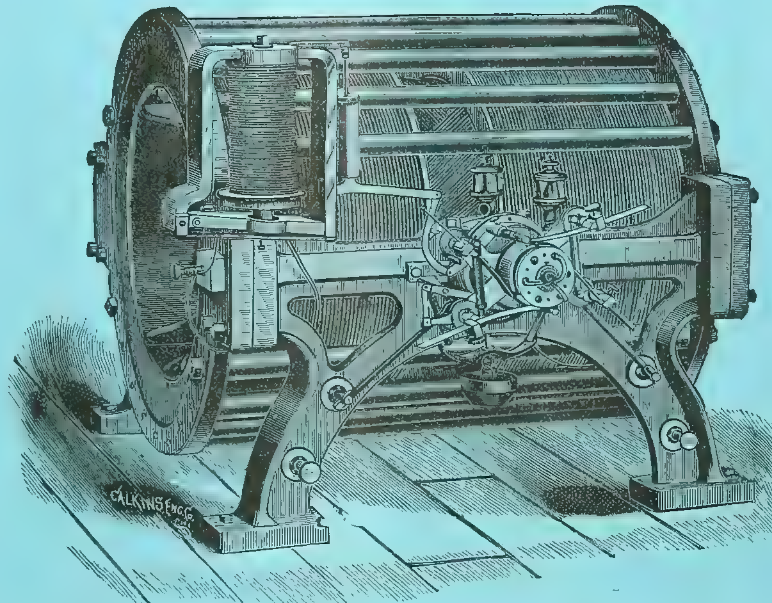

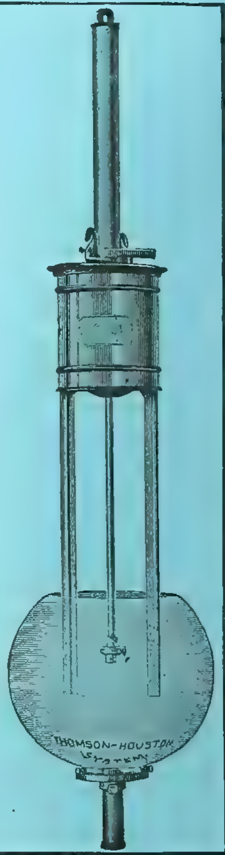

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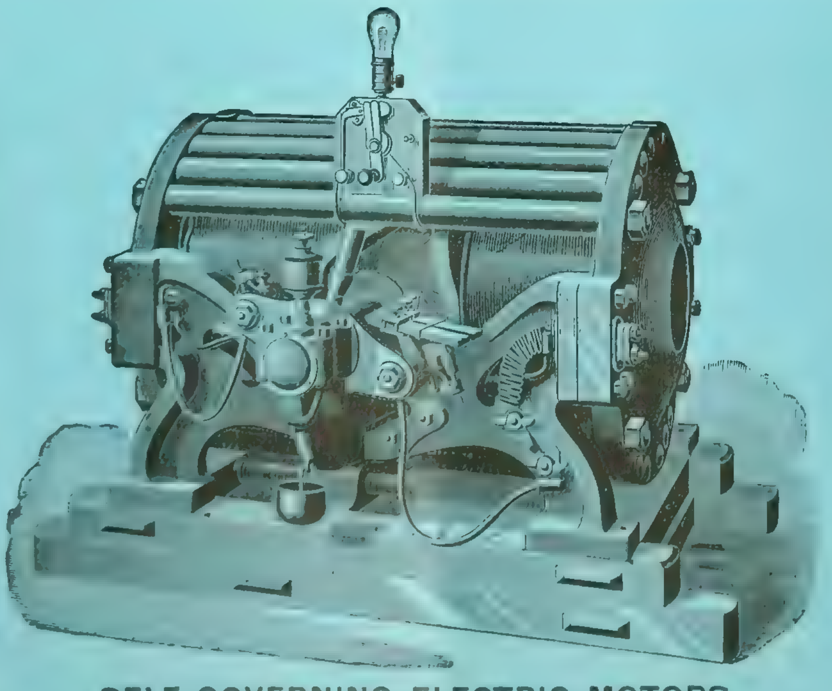

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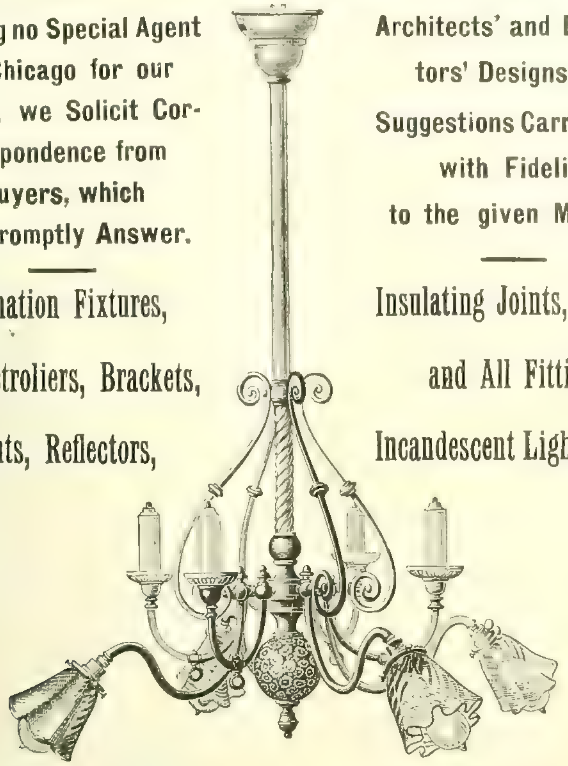

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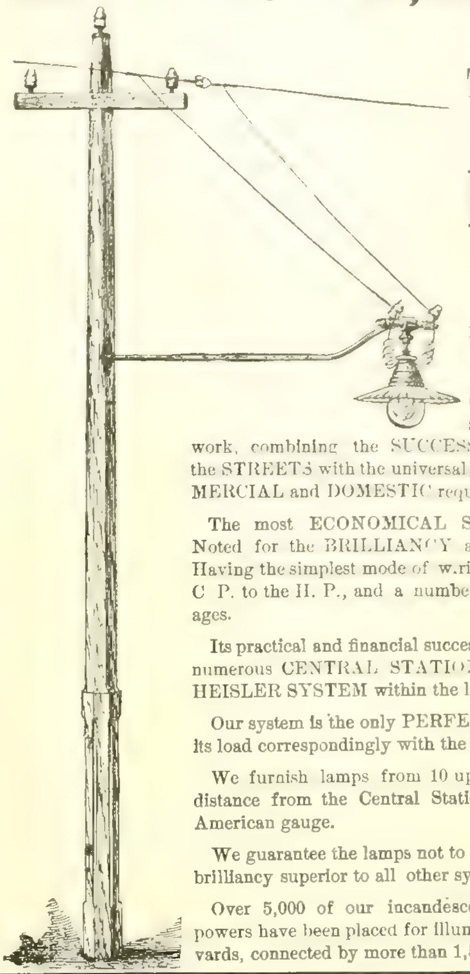

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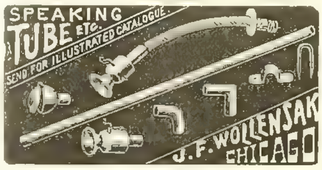

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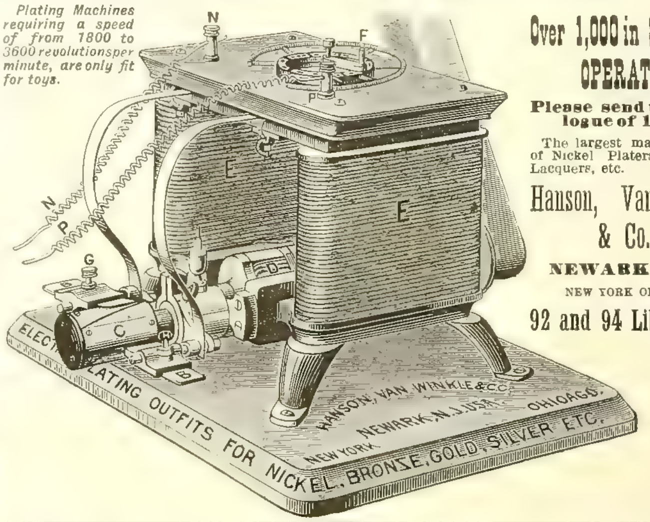

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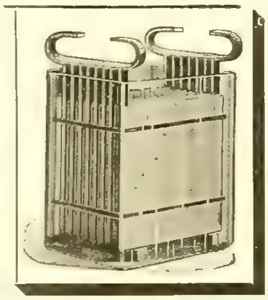

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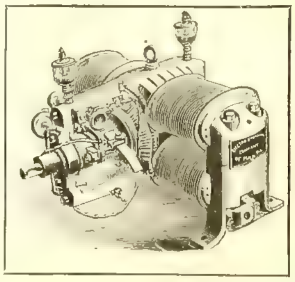

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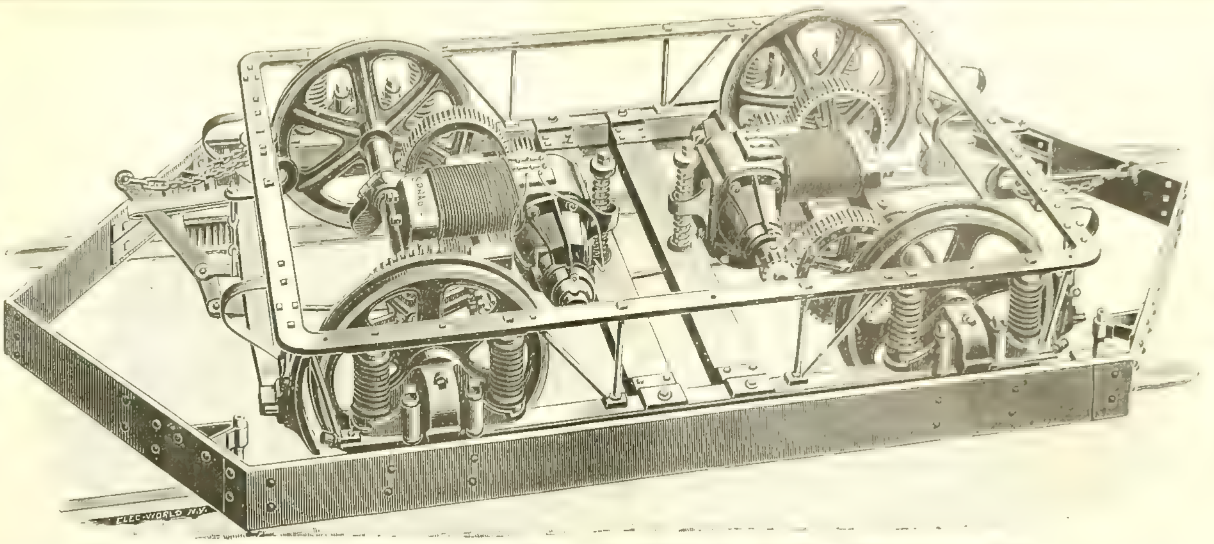

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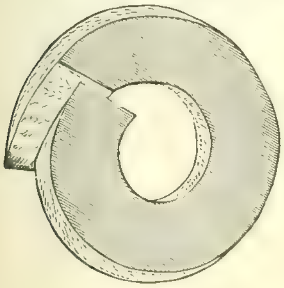

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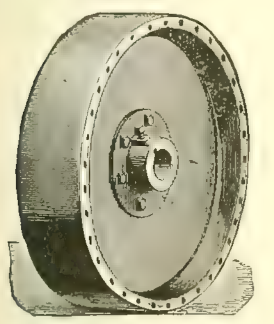

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Width, Iron, 12 inch; Paper, 3 inch (unsafe for belt).
Diameter, Iron, 48 inch; Paper, 24 inch for equal tension.
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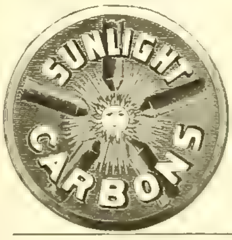

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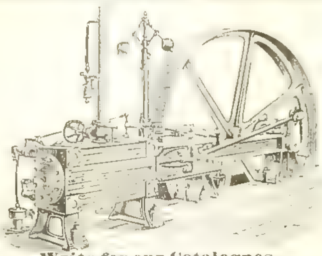

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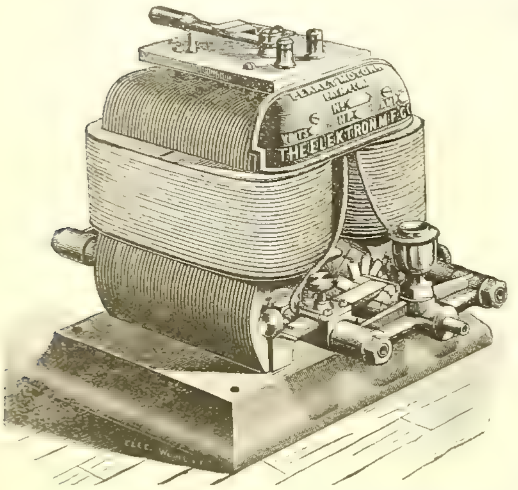

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Bids should be addressed to D. P. BEATON, Mayor of Oxford, Butler Co., O.

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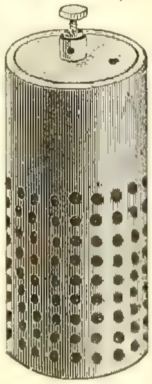

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PERFORATED BODY.
The only real improvement of a POROUS CUP.
NO SOAKING REQUIRED.
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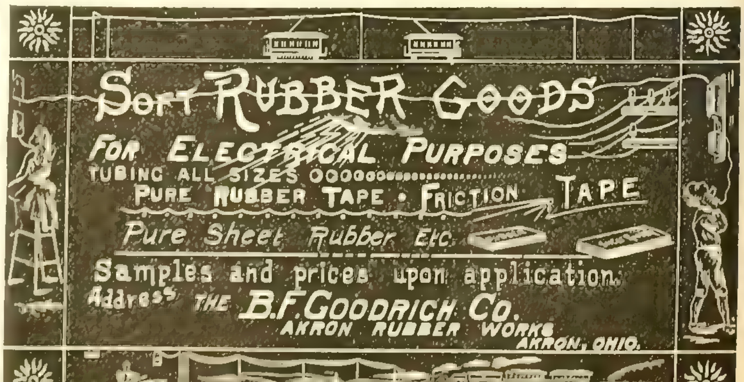

EDISON TRIUMPHANT!

His Patents Sustained by the United States Supreme Court.

THE EDISON ELECTRIC LIGHT CO.

Takes pleasure in announcing to its patrons and the general public that the decision of the Supreme Court of the United States, filed on the 21st ult., in the case of the Bate Refrigerator Company, is in fact a decision

SUSTAINING THE EDISON PATENTS

In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

Thus the QUESTION OF LAW having now been settled by the Supreme Court of the United States, and the QUESTION OF FACT by the highest experts of the world, this company now notifies the Public of its intention to call a halt and demand a reckoning for the trespass and abuse of its rights in

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150 CENTRAL STATIONS IN OPERATION. 150

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ISOLATED LIGHTING.

Efficient Apparatus!

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Incandescent Electric Lamps

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SUPPLIES FOR ELECTRIC WORK.

ELECTRIC AND COMBINATION FIXTURES.

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The illustration shows this new testing set, designed specially for

LINE MEN,

DYNAMO TENDERS

AND

BELL HANGERS.

It Consists of a Highly Polished Cherry Box,

containing a small dry

GALVANIC CELL,

DETECTOR GALVANOMETER

Of 500 Ohms' Resistance,

CONTACT KEY AND TWO BINDING POSTS.

The external dimensions of the box are 5 3-4x3 3-4x2 7-8.

Total weight, one pound and fifteen ounces.

The Galvanometer, Key and Binding Posts are mounted on a sliding Shelf, beneath which is the dry cell. By opening the end of the box, the shelf can be drawn out for inspection or repairs. The standard resistance of the coil is 500 ohms, but we will make them of any resistance to order. One cell will deflect the needle a few degrees, even through a resistance of 15,000 ohms.

PRICE FOR THE SET COMPLETE, $15.00.

KERITE WIRE.

We are sole agents for the sale of Kerite Wire for the Western States. This wire has been tested by years of actual service and stands at the head of goods of like character.

WESTERN ELECTRIC CO., - CHICAGO.

Western Electrician.

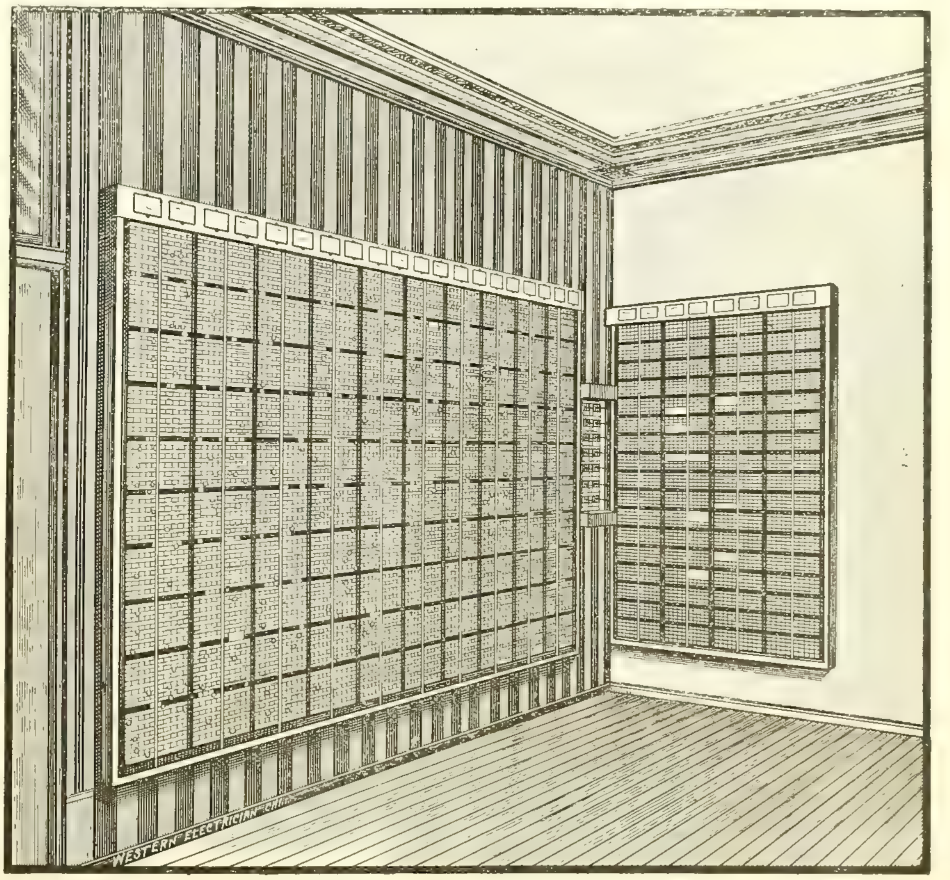
EVERY SATURDAY.

Vol. IV. CHICAGO, APRIL 6, 1889. No. 14

Trouble Board at the Chicago Telephone Exchange.

Since the introduction of the telephone, it has rapidly grown in public favor, its field has extended, and it has become a necessity in large business centers. This rapid advancement has made it necessary for the telephone companies to be constantly increasing their facilities for serving their patrons. As the list of subscribers grew, the difficulties of providing good service multiplied. The inventive genius of those interested in the development of telephony, however, is rapidly overcoming each difficulty as it appears. In the smaller cities and less important points where the service does not cover such an extensive territory, and include such a large number of subscribers, it has been found convenient and practicable to keep a record of complaints, inspections, repairs, etc., in memorandum book form, but in the larger cities this has been found insufficient. No other department of the service gave the companies so much trouble and annoyance as this, and as the service extended the trouble increased. In fact, the companies found the service deteriorating despite all they could do. This trouble has in a great measure been met in the Chicago telephone exchange. During the last year a new system has been introduced, and gradually developed until it is now as nearly perfect as can well be expected. It has proven satisfactory, and will undoubtedly be introduced in all the large exchanges throughout the country. The new system covers all the details of the inspection and repair department, yet its most striking feature is its simplicity.

In the headquarters of the repair department of the Chicago Telephone company is a large board, known as the trouble board, a glance at which shows the condition of the service in all parts of the city as well as the suburban districts. This trouble board is the principal feature of the new system, and is represented in the accompanying cut. The perpendicular strips show the subdivisions into which the territory is divided in distributing the work among the inspectors, each of whom has a certain district under his care of which he is held responsible. Within each of these subdivisions are parallel strips or ribs arranged horizontally and adapted to carry the blocks, upon which the numbers of the telephones are stamped. These blocks are 1 inch by ¾ inch square, and are dovetailed so they may slide between the horizontal strips and remain in position. The arrangement of the blocks in each district is according to the route which the inspector is obliged to travel over, and this is, of course, laid out with a view of covering the district conveniently and expeditiously. Each block has through its center a small hole about [illegible] inch in diameter, into which can be placed a brass or iron pin about an inch in length. A brass pin so placed in any block indicates that the telephone corresponding with the number which the particular block carries has been inspected during the current month. The Chicago Telephone company requires each and every telephone to be inspected at least once a month, and the brass pins in the blocks show the stage of this work at all times during the month.



TROUBLE BOARD AT THE CHICAGO TELEPHONE EXCHANGE.

These pins also serve to carry little disks of cardboard ½ inch in diameter, varying in shape and color to indicate the different kinds of trouble to which the lines and instruments are subjected. Whenever a case of trouble is reported to the repair department, the line involved is immediately tested for the purpose of determining the nature of the difficulty. The next step is to note upon a disk of celluloid one inch in diameter, which serves as an erasable tablet, the time the trouble was reported. This celluloid disk is then hung upon a pin which is first placed in the hole in the block bearing the number of the particular line or instrument in question. If it should happen that this particular instrument had not yet been inspected during the current month, and the brass pin had not been inserted an iron pin is inserted to carry the disk which remains until an inspection shall have been made, when the brass pin will be substituted for the iron.

[illegible] attended to every other day [illegible] trouble that may of necessity have been carried over night. When any case of trouble is reported at the repair department the disk is placed on the pin with the side exposed to view bearing the time. When this case of trouble is given to a repair man the disk is reversed on the pin, exposing to view the side carrying the number. When the repair man turns in his report, which is made on a printed form provided for such purposes, the celluloid disk is replaced by a small colored disk indicating the particular kind of trouble which caused the complaint.

At the end of each month the entire board is cleared of the pins and disks, a record, however, having been made from which a monthly statement is compiled, showing the number of complaints of different kinds as they are classified and the number of regular inspections. A careful record is made for the purpose of comparison between districts to show the relative merits of the work of different men and the condition of the instruments and lines. This system dispenses entirely with the book record, and shows to the foreman at a glance the exact condition of the lines and instruments with respect to troubles and the progress that has been made by the inspectors. The particular grouping of the little disks as they appear at the close of the month is most interesting, as it indicates the various localities where the lines may be in bad shape and cause trouble. This feature is of the greatest value in its significance.

The Chicago exchange contained on March 1st about 5,800 telephones, and in the same territory the company has upward of [illegible] private line telephones. These instruments are all represented on the Trouble board according to their location together, with the instruments in the suburban exchanges within a radius of [illegible] miles of Chicago.

The repair department is allowed [illegible] for inside and two hours for outside troubles, as a maximum time in which to make repairs. By "inside" is meant the instruments and batteries and lines inside of buildings, and by "outside" is meant the line wires proper.

The percentage of cases which [illegible] than this length of time is very small, and a special written report of explanation [illegible] foreman is always required in case [illegible]. Appended is a copy of the M[illegible] state[illegible]

ment, which will doubtless prove interesting to telephone managers.

The system of monthly inspections and the thorough watchfulness of this department of the business during the last year has reduced the [illegible] Chicago exchange nearly 70 per cent. When the record shows repeated troubles in the lines or instruments of any particular locality, a thorough investigation [illegible] trouble removed. It will be seen that the work of each inspector and foreman is made so conspicuous that he is constantly striving to make a favorable showing, and thus stimulated, the very best results are obtainable.

STATEMENT OF INSPECTION AND TROUBLE FOR MARCH.

CHICAGO EXCHANGE.

District.	No. of Telephones	No. of Inspections	Transmitter	Battery	Switch	Generator	Ringer	Cord	Inside Wire	Miscellaneous	Receiver	Total	Percentage of trouble to Inspection	[illegible] Department	Loose	Reports	Crossed or Ground	Open	Other	Total
	Instrument Department															Line Dept.				
Exchange	2223	[illegible]	2[illegible]	12	25	4	13	28	46	34	10	201	3.[illegible]		17	72	248	101	13	362
[illegible] Line	[illegible]	[illegible]		4	2	1	1	1	7	1	1	18	2.7		0	8	19	5	0	24
Trunk Line															11	1	15	5	0	20
Total	5[illegible]	[illegible],71	[illegible]6	16	30	5	14	29	53	35	11	219			25	87	281	111	13	406
SUBURBAN EXCHANGES.																				
	2[illegible]	[illegible]	[illegible]	1	1	0	0	0	1	1	0	4	[illegible]64		[illegible]	0	34	3	0	37

Average number of cases per day instrument 6.[illegible]
" " " " " " line 11.[illegible]

Pennock Primary Battery Electric Light.

In the Chicago *Tribune* of March 29th appeared an article relating to the Pennock primary battery scheme. It was stated that the inventor, George B. Pennock, of Chicago, promised much but accomplished little. It was insinuated not over-cautiously that Mr. Pennock's sole object was to induce the public to invest money in his primary battery scheme, and that the installations to which reference was made in the prospectus existed only in the inventor's glowing imagination. The spirit of the article is shown in the following extract:

"Now Mr. George B. Pennock says he can light every house in Chicago by electricity at the price of gas. He has been saying it for four months. He has said it by pamphlet and advertisement. He says it daily at his office in the Royal Insurance Building. He has taken thousands of orders from people who want him to do it. Yet Mr. Pennock has not done it. In the meantime Mr. Pennock is doing another thing. Moreover, he is doing it industriously. He is selling stock at $1 a share to people who believe what he says when he says he can do the other thing."

With the *Tribune's* article we fully sympathize. Electricians, as a rule, have little faith in any scheme of utilizing primary batteries for electric lighting. They have discarded that [illegible] method of generating electricity by dynamos. The return [illegible] is going backward.

In the *Tribune* of the following morning Mr. [illegible] states [illegible] economical, that he has been delayed in putting his system [illegible] methods are entirely [illegible] general tone of the letter, the [illegible] fair idea:

[illegible] If I am a [illegible] iliza- [illegible] th in [illegible] para- [illegible]

"It is not my desire or purpose to attack the dynamo systems, [illegible] and acknowledged fact that none of the dynamo systems in operation have been able to furnish a satisfactory light or return dividends on money invested. The vast sum of $50,000,000 has been invested in dynamo plants [illegible] and stockholders and consumers all over the world are making a combined 'kick'—consumers because they are being badly served, and the investors because they are getting no returns—while plants everywhere are becoming dilapidated and the catalogue of disasters to life and property is lengthening out with ominous rapidity."

Such outrageously false statements it would be hard to match. To contradict them would be superfluously absurd, and their falsity must be apparent to every intelligent person, whether he is interested in the development of electric lighting or not. As we have said, we have no sort of faith in the Pennock scheme, and if the claims of the inventor belong to the same class of statements as those we have just quoted, we know how to characterize them.

Drawbridge on Cambridge Division of West End Street Railway.

In building the overhead line from Boston to Cambridge the Thomson-Houston company was

THOMSON-HOUSTON CAMBRIDGE ELECTRIC RAILWAY.

obliged to design some special construction, shown in the accompanying cuts. That the [illegible] drawbridge would have no effect upon the operation of the cars on either side of [illegible] on it should be [illegible] the draw was [illegible] be no opportunity [illegible] the wire in pass[illegible] main bridge to [illegible] conditions of the [illegible]

[illegible] is solved by [illegible] A cable is brought [illegible] the drawbridge [illegible] lower part of [illegible] the switch is [illegible] of the bridge, [illegible] wire on the [illegible] opened the circuit is broken at the switch, and when it is closed the circuit is again completed, so that current may be supplied to the car for crossing. The main circuit is completed through another cable running underneath the draw from side to side. The accompanying cuts show in detail the method of suspending the overhead conductors. As will be seen from the illustrations, there are supported from the trusses by cone insulators two short pieces of iron pipe, to which the main conductor is fastened.

Two frogs are placed at the abutting ends of the trolley wire, which comes into line when the draw swings into place, and prevent the trolley from jumping the wire when it passes from the main conductor to that on the draw. Since the road was started the operation of this part of the electrical equipment, as well as that of the remainder of the devices used in the drawbridge, and the motor cars themselves, has been of the most satisfactory nature. It may be mentioned here that out of the first 1,179 trips made by the electric cars, but nine trips were lost, and this was simply due to lack of experience of the motor men. Such a record speaks well for the reliability of the apparatus.

Thermo Electric Company.

The Thermo Electric company has been organized in New York city, and officers have been chosen as follows: President, E. N. Dickerson, jr.; vice-president, Max Mestern; secretary and treasurer, Charles Iden. The capital stock is $1,000,000. The company controls the patents recently issued to Max Mestern for a thermo-electric battery, which was described in the WESTERN ELECTRICIAN of January 26th. The company will begin operations immediately. Mr. Iden was in Chicago last week. In conversation with a representative of the WESTERN ELECTRICIAN, Mr. Iden said the great advantage of this invention was its cheapness. It would be within the reach of all, and the poor man could light his house by electricity as well as his rich neighbor, and do so, moreover, at less expense than at present.

"Why," said Mr. Iden, "I can run an arc light and twenty incandescent lamps from one of these batteries with 50 cents worth of coal all day. You may think I am exaggerating, but I am not. I am ready to prove what I say; in fact, I am preparing a permanent installation in my establishment in New York city now, and will soon have it in operation. There can be no question as to the durability of this device. That has been an objection to former inventions. In this case, however, it has been obviated. I have subjected the battery to severe tests much more severe than it would receive in practical use and it came out all right."

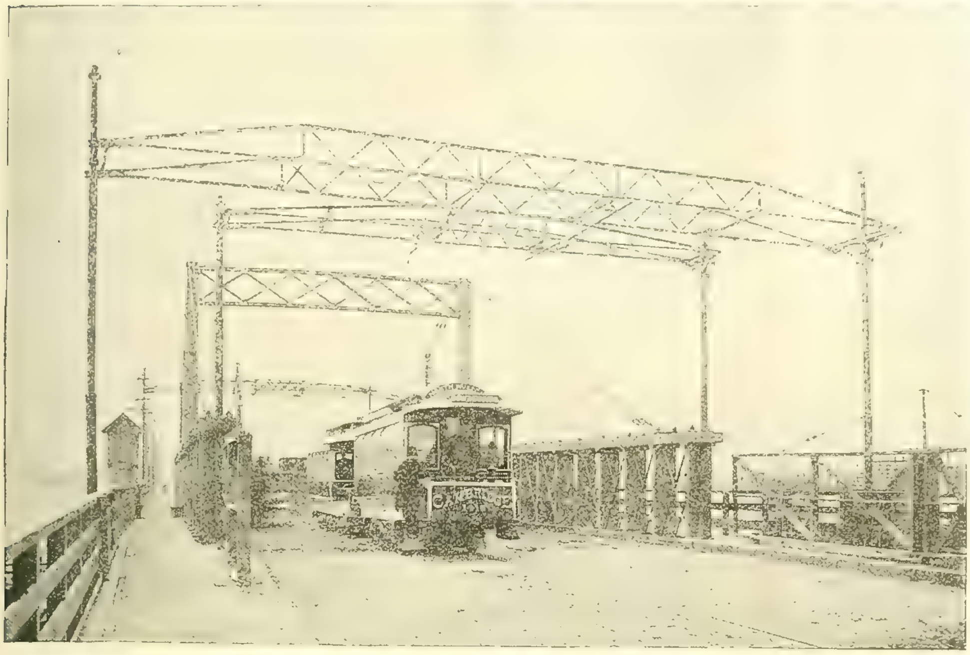
It is not anticipated that the battery will be used for extensive illumination in large establishments, though it is claimed this can be accomplished, but it is expected that men of moderate means will utilize it for lighting their houses. In large cities like New York, Chicago, Philadelphia and Boston there are very many [illegible] furnished flats. The occupants of

these flats, Mr. Iden said, can light their apartments by electricity by having one of these batteries attached to their stoves. Mr. Iden says: "They can not only light their homes by electricity, but they can run the sewing machine, rock the cradle, operate ventilating fans, and use it for a hundred and one other things about the house."

High and Low Tension Arc Lighting.

BY [illegible] B. BADT.

In reading the number of the WESTERN ELECTRICIAN of March 30th I see that at the last Electric club meeting a discussion took place on



THOMSON-HOUSTON CAMBRIDGE ELECTRIC RAILWAY.

Mr. Cutter's paper, in which one of the gentlemen tried to show that some of the facts I gave in my article on "High and Low Tension Arc Light Systems," published in the WESTERN ELECTRICIAN of Jan. 26th, 1889, were not quite correct. Unfortunately business kept me away from Chicago, and I could not attend that meeting myself, and, therefore, could not take part in the discussion to contradict statements which were made.

The main point in the discussion was the statement that the cost of copper conductors was so much higher in the low tension than in the high tension system that as a consequence the high tension system, as such, was much more economical than the low tension system.

I think that I treated this question very fairly in the above mentioned article, and showed, under the heading "Cost of Copper Conductors," that the ratio of the amount of copper, or the ratio of the cost between the high and low tension systems, was as 1 : 3.24.

This simply shows that if we put in 3.24 times the amount of copper in the low tension system than would be required for the same number of lamps in the high tension system, the same amount of energy would be wasted in the lines.

If, for instance, a firm contracts to put up a whole plant complete, including outside wires, and guarantees the same amount of horse power to be wasted in the low tension as in the high tension circuit, it certainly cannot be said that the low tension system is not as economical to the purchaser of the plant as the high tension system. What does it matter to the purchaser whether the contractor puts up a little more or less copper wire in the circuits, as long as he is not to pay for it? In circuits of a length under one mile the difference in the amount of horse power wasted in the electric wires is really so trifling that it does not matter whether we use high or low tension.

Appended is a table showing the loss in horse power per mile of an arc light circuit. Say, for instance, that in using the smallest size wire, which the underwriters will allow, which is No. 6 B. & S. wire gauge, that the amount of mechanical horse power wasted in one mile of circuit is about [illegible] horse power, while [illegible] tension system it is about 1 horse power. Think of the terrible waste of power, [illegible] horse power, when, for instance, you are running, say, thirty lamps in a circuit! Of course, the longer the circuit, the more [illegible] ence in the loss [illegible]; but as it [illegible] use No. [illegible] wire for the low tension system, [illegible] No. 6 for the high tension system, [illegible] [illegible] we would get for a ten mile circuit [illegible] high tension system a waste of about [illegible] power, and in the low tension system [illegible] horse power.

Now there really is a little over [illegible] horse power difference between the two systems on the ten-mile circuit. What does this amount to, even if there are, say, only fifty lamps on the circuit, which will probably be the smallest number on a ten-mile circuit, and taking into account all the other advantages of a low tension system, such as explained in my previous paper? These are the facts looked upon from a commercial point of view.

I do not wish it to be understood that I am an advocate of the low tension system. As a matter of fact, the company with which I have the honor to be connected has lately sold a large amount of high tension apparatus, and a large number of lamps of this system; in fact, more high tension than low tension. The only point I want to make is that one-sided statements made by an advocate of a certain system, either low or high tension, should be taken with a grain of allowance. They really do not set forth the facts to the public in such plain language as to enable every one to understand clearly what there is in this question of economy of high and low tension systems.

I have also been told that an experiment was made in connection with the paper which was read at the Chicago Electric club, in which the [illegible]

horizontal line, while the long arc sends the [illegible]

I think the facts are entirely distorted. Mr. Cutter also speaks of the *reddish* tinge of the short arc. The spectrum does not [illegible], however, with Mr. Cutter's views. The spectra of low and high tension arc lights show that the short arc emits [illegible] light than the long arc, in which blue and violet rays predominate.

I state these facts so the readers of the WESTERN ELECTRICIAN may not be misled [illegible] statements made during that club meeting, and I am ready to argue this question, not only with city councils, but with any one at any time before the Chicago Electric club.

Horse Power Lost Per Mile [illegible]

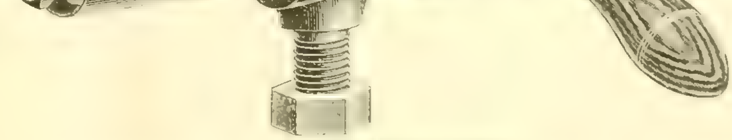
Brown & Sharpe Wire Gauge.	Electrical horse power	Mechanical horse power
10 Ampere High Tension.		
No. 4.	.172	[illegible]
" 5.	.217	[illegible]
" 6.	[illegible]	.328
18 Ampere (Low Tension		
No. 4.	[illegible]	.669
" 5.	[illegible]	[illegible]
" 6.	[illegible]	[illegible]

Electrical horse power found from formula H. P. = [illegible] R / 746

Mechanical H. P. = Electrical H. P. [illegible]

Fuel Oil System.

That electric light companies are interested in the experiments in burning crude oil for fuel was demonstrated by the fact that three papers relating to the question were presented at the last convention of the National Electric Light association. Improvements in the burners and in fuel oil systems are constantly being made. The accompanying cuts illustrate the system of the Racine Hardware Manufacturing company. Fig. 1 is the crude oil burner, which is made in sizes adapted for boilers of from 1 to 15[illegible] horse power. Its adjustment is such that it secures a thorough atomizing of the oil. The oil trap is shown in Fig. 2. It will be seen that when the oil level is reached the supply will be [illegible] by the float rising and closing the [illegible]. The outlet to the burner being above the [illegible], and the oil supplied to the burner by the [illegible] created, there can be no overflow. Thus both safety and economy provided for. [illegible]



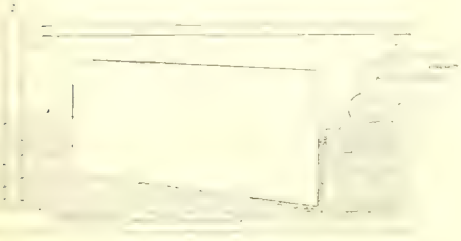
RACINE FUEL OIL SYSTEM.

[illegible] (indicated by the dotted lines), through which all the oil must pass before reaching the discharge pipe. The [illegible] or depression in bottom of the trap is for the accumulation of sediment, which with water accumulations can be drawn off through a cock [illegible] bottom of trap. Fig. 3 is a sketch showing the system of tanks, piping and traps used in the works of the Racine company.

The Book Table.

[illegible] By [illegible] Co. [illegible]

This book, which is written in popular style, is designed, according to the author, first, for those who are interested in obtaining state or municipal legislation; second, for those who are or are about to become interested in electric central stations, and, third, for manufacturers, to assist them in opening new fields for their apparatus. Mr. Foote emphasizes his belief that the true functions of government are "to regulate and control, not to own and operate" electric light stations. He gives a brief sketch of the development of electric light and power service, and speaks of the significance and importance of these industries in a city. A complete electric service of a city the author defines as one which will meet the following requirements: "First, the apparatus used must be capable of supplying a light, arc or incandescent, at any point in the city where a light is required; second, it must supply the incandescent lamp by meter measurement, so that payment is made for the lamp when in use only; third, it must supply motor power in such quantity as needed at any point in the city, where wanted for manufacturing or other mechanical purposes; it must supply motor



[illegible]

power for operating the street cars." Mr. Foote believes that a city should grant to one company only privileges sufficient to enable it to provide this complete service, at the same time exacting guarantees that all the requirements of a complete service shall be met. Included in the book is a considerable amount of interesting matter, which has already appeared in the electrical journals and in magazines.

Edison Central Station at Milan.

[illegible] at Milan is shown in the accompanying sketch. [illegible] lamps. In the station are several Zipernowski-Deri alternate current generators, used for supplying [illegible] erintendent [illegible] and

American Bell Telephone Company

The annual meeting of the American Bell Telephone company was held [illegible] President Howard Stockton read his annual report. Bearing upon the long distance telephone business the report was as follows: "Your directors, believing that a part of the income from royalties should be treated as capital, have transferred $600,000 from the net surplus for the year to a reserve account. The lines of the American Telephone & Telegraph company have been extended during the year 1888 from Albany to Buffalo, and new lines have been built from Chicago to Milwaukee and from Boston to Providence. An additional pole line has [illegible] been constructed between New York and New Haven. Altogether, about $2,200,000 has been spent on the long lines, which now comprise 26,035 miles of wire. The greater part of this money has been obtained by the issue on the [illegible] of August last of $2,000,000 7 per cent debenture bonds of the American Bell Telephone company, which were offered to the stockholders at par. The whole amount was [illegible], except twelve bonds of $1,000 each, which were afterwards sold at auction."

The report gives the following figures:

Earnings—	1888	1887
Rent of telephones	$2,483,270.34	$2,264,523.94
Dividends	1,213,880.58	1,013,036.90
Extra territorial and branch lines	28,711.18	80,443.67
Telegraph commission	2[illegible],164.[illegible]2	10,002.31
Interest	90,466.65	70,235.68
Miscellaneous	7,634.54	4,525.11
	$3,865,118.48	$3,453,027.70

Expenses—	1888	1887
Operation	$274,442.00	$242,205.06
Legal	222,257.75	207,079.05
Interest and taxes	207,212.68	130,174.70
Commission . .	467,471.10	433,578.37
Royalty . .	10,000.00	11,000.00
Concessions . .	207,790.27	180,765.38
Miscellaneous	61,739.46	19,027.33
	$1,450,913.26	$1,242,430.89

Summarized, the results of operation were as follows:

	1888.	1887.	Increase.
Gross earnings	$3,865,118	$3,453,028	$412,090
Expenses . . .	1,450,913	1,242,431	208,482
Net earnings	$2,414,205	$2,210,597	$203,608
Miscellaneous .	22,258	27,011	4,753
Total net .	$2,436,463	$2,237,608	$198,855
Dividends	1,790,878	1,568,336	221,542
Surplus . . .	$645,585	$669,272	$22,687
Reserve for general depreciation	600,000	. . .	600,000
Balance	$46,585	$669,272	$622,687
Reserve for depreciation instruments	46,585	132,616	86,031
Net surplus . . .	.	$536,656	$536,656
Total surplus Dec. 31st	2,028,036	2,028,036	.

* Decrease.

It will be seen that in reality the net surplus increased $63,344 over 1887, but this year $600,000 were put aside as a reserve for general depreciation, rather than being added to surplus, and the latter is held the same as last year. The report says of this that the directors believe that a part of the income from royalties should be treated as capital, hence the transfer of the $600,000 from net surplus to a reserve account. Dividends of 12 per cent. regular and 6 per cent. extra, or $18 per share were paid in 1888 against $16 per share in 1887. The company earned $24.45 per share on the stock against $20.80 in 1887. The ledger balances December 31, 1888, were as follows:

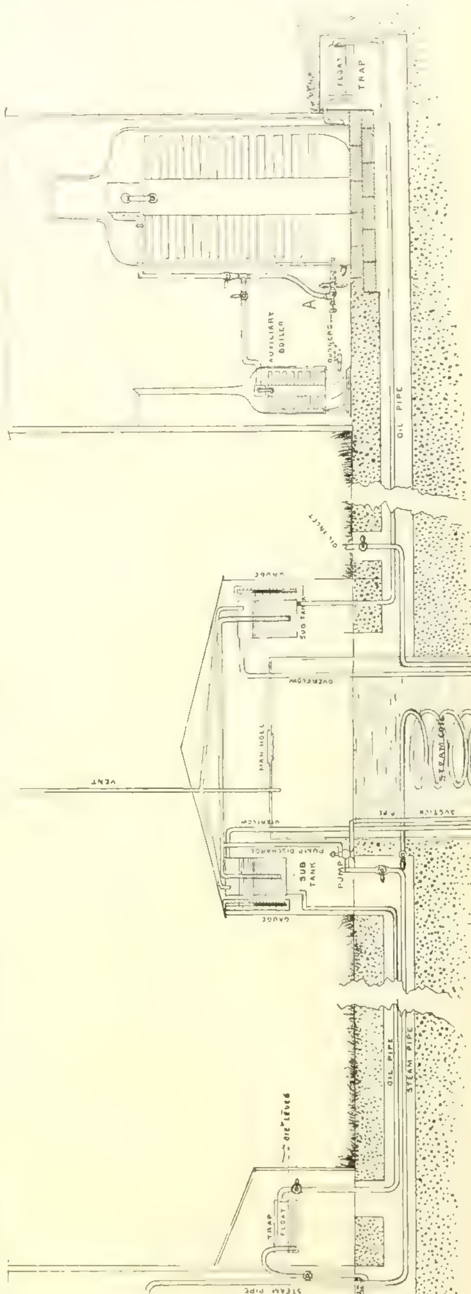
[illegible]

Compared with 1887, the principal changes shown in the above are: Telephones increased, $82,735.52; stocks increased, $2,109,400; bills and accounts receivable, increased, $415,269.10; and cash and deposits increased $548,991.85; the item "real estate" being a new one in the assets. Capital stock increased $160,000; the issue of debenture bonds is added in this year's statement of liabilities, and reserve is $733,077.55 greater than December 31st, 1887. This statement figures the stock at about $200 per share.

Telephones	$745,817.45	
Real estate	3[illegible]74	
Stocks	2[illegible]03	
Merchandise and Ma[illegible]		
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]		[illegible]
[illegible]		[illegible]
[illegible]		[illegible]
[illegible]		[illegible]
[illegible]		19,122.88
[illegible]		[illegible]
[illegible]		[illegible]

[illegible]

miles of wire, increase 24,033. Total circuits 143,687, increase 11,683; total employes 6,310, increase 127; total subscribers 171,454, increase 12,742. Number of extra territorial lines 947, increase 20; miles of pole lines on same 34,010, increase 1,532; miles of wire on same 73,293, increase 17,114. Total underground wires January 1, 1889, 17,038, increase 9,029; American Telephone & Telegraph company's long distance wires 327, increase 187; instruments in hands of licensees, under rental December

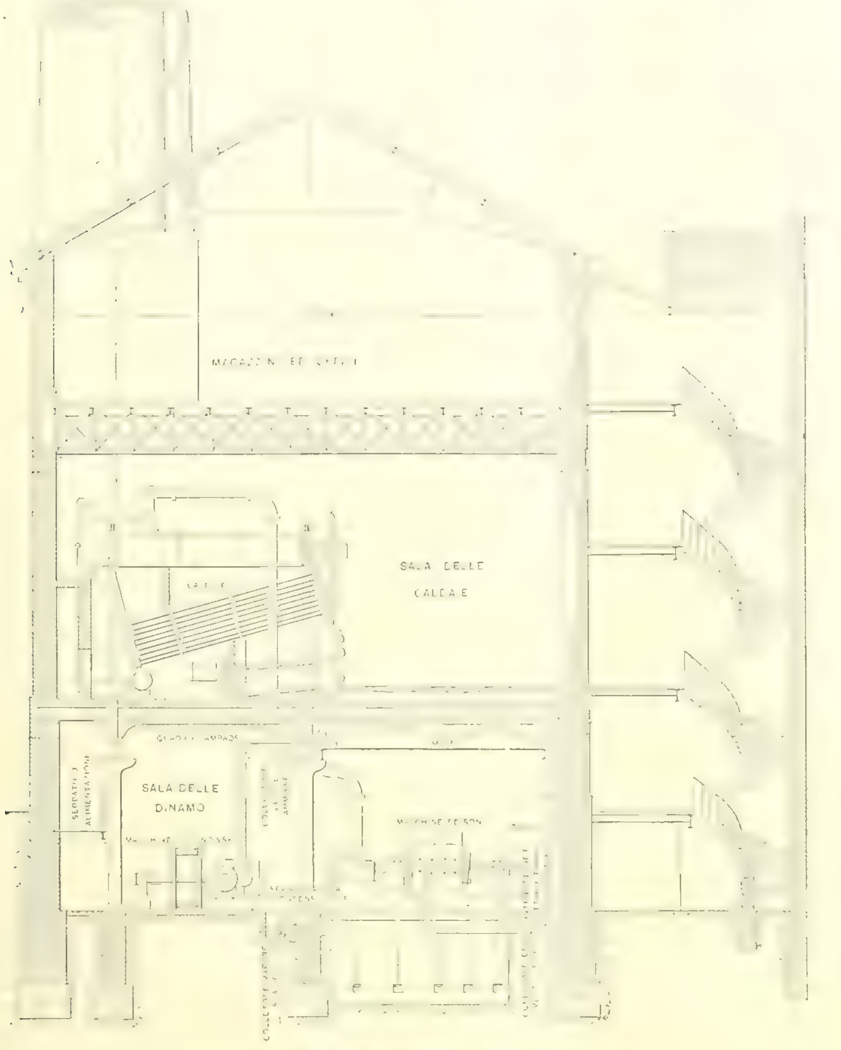


[illegible]

20th, 1888, 411,511, increase 31,234. The estimated number of exchange connections daily in the United States is 1,0[illegible], or a total per year of [illegible],590. The number of daily calls per subscriber varies in different exchanges from three to fourteen, the average throughout the United States being 6[illegible]. The average cost to the subscriber varies, according to the [illegible] of the exchange and the character of the service, from 2 to 5 cents per connection. The average daily number of territorial connections is 7,222, or a total per year of 2,6[illegible],030. The extra territorial earnings for the year amounted to $771,734.2[illegible] (against $565,718 -

46 in 1887) of which the Bell company's share was $7[illegible] 792 67, an increase over 1887 of $[illegible] [illegible] put of instruments under rental was [illegible] over 1887, and the largest number since 1883. The mileage of wire is 213,764, against 201,[illegible] in 1887. [illegible] the local companies are replacing iron wire with copper for extra territorial work.

The report was adopted. Charles Eustis Hubbard was [illegible]



EDISON STATION AT MILAN.

declared elected clerk by a unanimous vote William R. Driver was chosen treasurer, and a ballot taken for a board of twelve directors, resulting in the election of the following: Francis Blake, Stanton Blake, Charles P. Bowditch, George L. Bradley, Alexander Cochrane, William H. Forbes, Charles Eustis Hubbard, Gardner G Hubbard, John E Hudson, Charles E. Perkins, Thomas Sanders, Howard Stockton.

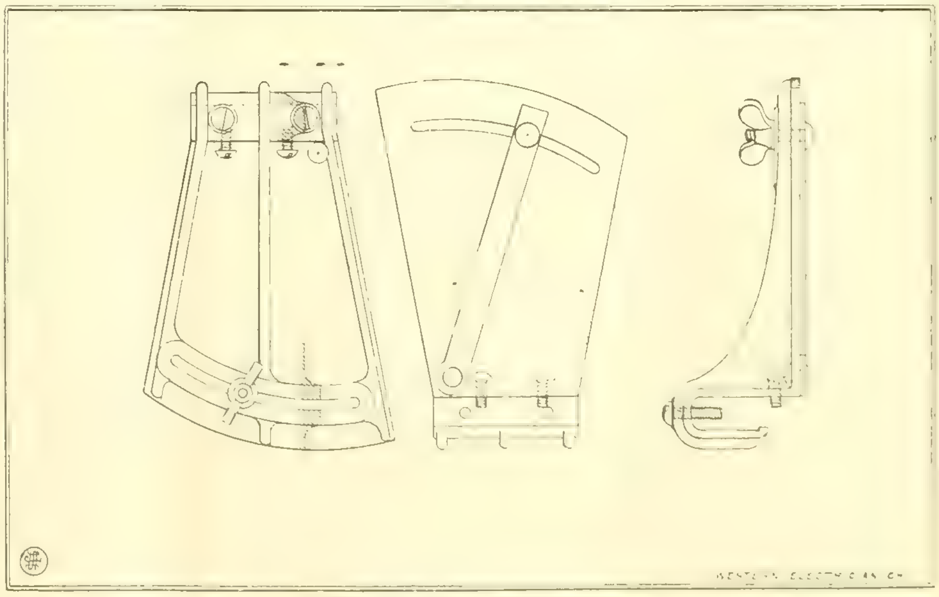
Cutter Adjustable Brush Trimmer.

The accompanying cut represents a simple attachment to an ordinary pair of "snips" or metal shears, to serve as a guide in trimming thin brushes. A description was given in No. 1 of the DAILY WESTERN ELECTRICIAN. The cut represents a vertical section, and top and bottom views. The instrument is made very light, and is designed to be fastened to one blade of the "snips," the gap into which this blade sets being made wide enough for the different sizes of "snips" used in electric light stations. Two screws at the bottom of this gap adjust the height of the table, and two binding screws at the side bind the instrument to the blade of the 'snips." When once adjusted to a pair of "snips" the screws at the bottom of the gap can be fastened permanently, and their adjustment need never be changed. The instrument can then be removed readily from the "snips" in case these are to be used for other purposes. It is adjusted so that the table is level with the cutting edge of the "snips;" on the top of the table is a swinging arm, furnished with a binding screw, which serves as a guide for the brush. This can be set so as to trim the brush square, or at any desired bevel.

This instrument is one that will be greatly appreciated by persons in charge of dynamos, as it not only affords a means of doing the work [illegible] [illegible] the [illegible] [illegible] invention of George Cutter, Chicago.

Chicago Electric Club.

The regular meeting of the Chicago Electric club was held last Monday evening, President S. A. Barton in the chair. Treasurer Terry presented his report, showing that the receipts during the last quarter amounted to $726.15, and the disbursements $718.28, leaving a balance of

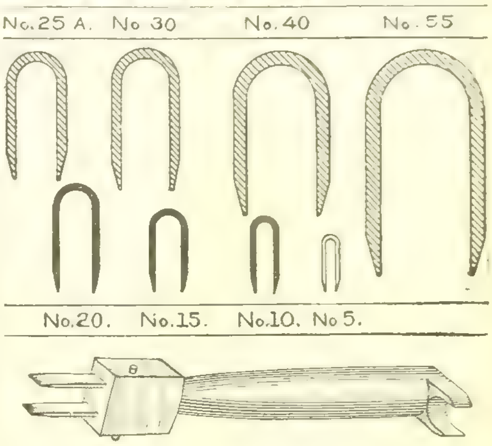


CUTTER ADJUSTABLE BRUSH TRIMMER.

$7.87. He also reported that the amount outstanding was about $200 The secretary's report showed that twenty-three new members had been added, of which eighteen had qualified The report showed that the club was in a pros[illegible] [illegible] w quarters. Several available local[illegible] [illegible] ting of M[illegible] Zimmerman, Kreidler and Kempt, and the meet[illegible] sidered.

Safety Insulating Staples.

The accompanying cut shows a [illegible] of safety insulating staples. They are [illegible] building wires [illegible]



boards. With the ordinary iron staple there is danger of cutting the insulation, and as a consequence leakage is apt to follow. The copper may be corroded by moisture, electrolytic action may be set up, or the conductor itself may be fractured by direct contact or pressure of the staple. With the insulating staple it is claimed these dangers are obviated, as injury to the insulation is rendered impossible. There is, in fact, a reinforcement of the insulation. The staples are put on the market by the Simplex Electrical company of Boston. The form of the driving tools, which are adapted to each size of staple, is also shown in the cut

Death of E. P. Allis.

Edward P. Allis of E. P. Allis & Co , Milwaukee, died at Milwaukee, Wis., Monday evening, April 1st. The deceased was one of the best known manufacturers of machinery in the country. In 18[illegible] he became interested in the Reliance Iron Works, which were at that time [illegible] his business [illegible] prestige and [illegible] At the time of his death he was [illegible] of the works. The deceased was born [illegible] May 12, 182[illegible], and received a liberal [illegible]

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CORRESPONDENCE [illegible] or any of its prac[illegible] the co-operation of all [illegible] earnestly [illegible] Clear, con[illegible] welcome, and communi[illegible] newspaper clippings, or any in[illegible] interest [illegible] will be thankfully [illegible] acknowledged.

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[illegible] .... [illegible]

A CHICAGO paper devoted considerable of its space last week to a review of the operations of a primary battery electric light scheme. A summary of the controversy is given elsewhere.

IT is proposed to extend the electric light plant of Chicago, and an appropriation of $300,000 has been promised for this purpose. City Electrician Barrett is besieged with requests from citizens who are anxious to have the district in which they live favored. As soon as the money is placed at his disposal he will begin [illegible]

THE [illegible] has [illegible] which has caused such commotion among tele[illegible]

[illegible]

[illegible] new system [illegible] form, as it is apparent to [illegible] experience in this department [illegible] device, and will greatly facilitate [illegible] work of the repair department.

IN a recent [illegible] devoted to telephony, published in Engla[illegible] "S. S. Cox" appears. The auth[illegible] work evidently imagines that the genial and humorous New York congressman is a steamship.

COPPER dealers are still in the dark as to the probable outcome of the trouble in the syndicate and its bearing on the copper market. It seems to be the general impression, however, that the market will decline. A Chicago dealer expressed the opinion to a representative of the WESTERN ELECTRICIAN, that there would soon be a decisive step. If the syndicate can secure the backing necessary to carry it through the fight, it will soon show a bold front and push the market back to the notch it had reached when the break came; but if it should be unable to continue the fight after the present arrangement expires, it will soon go to the wall. "It places the dealers in a bad position," he added, "as they are entirely in the dark. The price is fixed by the syndicate at a secret meeting, in which we are not only not represented, but it often happens we do not know a meeting has been called until the result is announced in the form of a change in prices. Unless we are careful we are liable to load up with copper only to have the price cut immediately. It is questionable if it is a good thing from a business standpoint to raise the price to such figures. You see, people will not buy any more than they can help at such figures, and they will discard the use of copper wherever they can. You have no idea of the difference it makes in the sales to have them using galvanized iron instead of copper for mechanical purposes. While consumers were restricting the use of copper, the mines were increasing their output; consequently the market was soon overloaded. It is a great wonder to everybody familiar with the question, that the syndicate was not swamped long ago."

IN the New York letter a reference is made to the recent explosion in one of the conduits. Fortunately no one was seriously injured, though there were a number of na row escapes. Wherever wires are buried accidents of this kind are apparently liable to occur, and Chicago has not been free from them. There seems to be no question that the explosions are caused by the ignition of illuminating gas which leaks from poorly constructed mains. A good deal of study has been devoted to means for preventing explosions of this kind, and the scheme of constructing the subways comprehends a system of pumps or fans along the line. The recent severe explosion has caused the people of New York to become interested in the matter, and the officials of the Board of Electrical Control have been called upon for explanations. It will be remembered that no current was passing through the mains when the explosion occurred.

Chief Engineer Kearney of the Board of Electrical Control says: "It is well known that the gas companies lose about one-third of their product by leakage. These gas mains have, some of them, been in the ground thirty or forty years; some of them have rusted away so that they will not hold together. The com[illegible] it is not to their [illegible] mains. It appears that [illegible] is largely invested in them. [illegible] capital is so [illegible] The sewers of the [illegible] gas, and there [illegible] loss of life from [illegible] by workmen cleaning the [illegible] the explosion at [illegible] last summer the [illegible] through that [illegible] the least [illegible] the ends were sup[illegible] One of [illegible] that the gas [illegible] [illegible] and [illegible] It is the greatest wonder that there was not an explosion in the hotel. The gas was pouring rapidly into the basement of one of the stores. Now that this great leak has been discovered and stopped, there is a visible improvement in the atmosphere of that locality. What actually happened was the lifting of the covers of the subway and disturbance of the pavement. How the spark got there is a matter of conjecture. It may have come through some of the connections. The curious part of it is that our men had just been at work clearing out the subway. They began at Twenty-third street, and got up to Twenty-sixth street. I have no fear of any explosion in the subways that will hurt anybody."

Secretary Moss of the Board of Electrical Control, said: "We have notified the gas companies that they must repair their pipes and mains. There are five companies that have mains near this explosion, and we have noticed each of them to make sure of getting the right one. I have seen the workman of a gas company tearing up the street in half a dozen places to find one leak. These gas leaks are a great nuisance and they must be stopped in some way. They have caused a great trouble and expense to us in building the subway. The work of searching for a leak is extensive, and where different companies have their pipes near together each is willing to let the other search for a leak."

S. S. Wheeler, expert of the board, said: "There was no electric spark in the subway to ignite the gas. We have now $300,000 worth of cables in the subway, and they are being connected as fast as possible."

Commissioner Gibbens is convinced that the gas leakage amounts to at least one-third of the amount manufactured, and that the public health and safety are much endangered by the enormous quantity of gas that is mixed with the atmosphere.

It is to be hoped that the question will be thoroughly investigated by the board, as it is one of the most vital interest to a large number of companies, who may be called upon sooner or later to bury their wires.

STREET railway men throughout the country are anxious to find a substitute for the horse. It would seem that the electric motor would serve the purpose admirably, but this opinion is not universal. A journal devoted to the interests of the street car companies has been collecting statistics concerning the industry, and recently sent out letters asking, among other questions, whether the use of motive power other than animal power was contemplated. A sufficient number of replies was received to justify the conclusion that the preferences expressed represent very fairly the views of street railway men generally. Eighteen per cent. of the companies addressed contemplated no changes, and of this number one fourth expressed themselves as satisfied with horses, or were unable to make a change on account of the terms of their franchises. Sixteen per cent. of those who replied were waiting in a spirit of cautious conservatism. Sixteen and a half per cent. favored methods of propulsion other than electrical systems. Thirty-four per cent. have decided on or contemplated the use of electric motors with overhead system, conduits or storage batteries. Fifteen per cent. made no replies on the question of motive power. Sixty-six and a half per cent. of the companies, therefore, at least, are ready to make a change in their systems. The figures are interesting, and it is a significant fact that more than half of those who wish to dispense with horse power express a decided preference in favor of an electric system. If opinions had been asked for a year ago the number favoring an electric system would have been far less; a year hence it will be much greater. The most enterprising street railway managers throughout the country have already expressed their belief that electricity will be the future motive power for street cars. The only obstacle in the way of an almost universal change to the electric system is the spirit of timid conservatism. Street car men realize and admit that electric systems are successful, but they want to wait to see if they are successful over a period of years.

American Institute of Electrical Engineers.

At the conclusion of Prof. E. L. Nichols' paper on the "Efficiency of Methods of Artificial Illumination," which was read before the American Institute of Electrical Engineers, the following discussion took place:

MR. UPTON: I listened with great pleasure to the paper of Prof. Nichols. I think that we have heard a paper which puts more clearly than it has ever been put before, the subject of candle power. For the last few years there has been a considerable discussion regarding candle power. It is a matter which enters very largely into my business. I think that what Prof. Nichols has said as to the amount of light that a low candle power would give for illuminating purposes, is very marked. For example, you take a fire and you will notice how it will illuminate the buildings around, and yet the candle power of that is low. Where you have a low glow of coal, the candle power is very low, yet the illuminating power that you can see by is very large. As to the artificial method or fixed method of rating candle power in incandescent lamps, I consider that the present method of calling an incandescent lamp 16 or 20 candle power is entirely wrong. Incandescent lamps are simply sorted. You put them in at 100 volts or 105 volts, so that they will be even if burned. That is all it means practically. Each consumer of light should fix the candle power to suit the conditions. The marking that is now done on incandescent lamps is merely nominal; that is, it is in the hands of the parties who use the light to make the candle power as much as they like.

DR. OTTO A. MOSES: I too have listened with a great deal of pleasure to the paper and to the comments on it of Mr. Upton, and it carries me back to the day when the determination of candle power was the all-absorbing problem—the day when it was the question whether the incandescent light had any reason for existing or not. However, the concluding remarks of Prof. Nichols open up, I think, the proper field for us to cultivate to-night, and that is the method by which we can arrive at some photometric standard. The method that he proposes has one very great difficulty. He suggests the direction, but it is like pointing to the stars—you may go on to infinity. Carbon which is the material now used for furnishing the incandescent filament depends for its atomic condition upon the degree of temperature at which it has been distilled. There were some experiments carried on in the laboratory where Prof. Nichols and Mr. Upton were at work, by Prof. Young of Princeton, in which he determined that with an increase of incandescence in the filaments there seemed to be a diminution in the hydrogen of the filament up to the point of the destruction of the filament, when the hydrogen seemed to disappear. That observation was made by him, and I think by Prof. Brackett, proving that you are getting an increase of density in that carbon filament for each degree of increase of temperature. If you are to have a standard for photometric capacity, that standard should also be a definite heat capacity. The amount of light given off for different metals would vary according to that capacity, and you are getting for each increase of temperature in the production of that carbon filament a different degree of density, and consequently it would be impossible to take the dimensions and amount of current consumed, and from those two produce some limit of candle power. The experiment where light was decomposed seems to be perhaps the most pregnant one for us to derive a photometric method from; for as in the decomposition of light we could recompose after we had determined the limits of action of each one of the colors of the spectrum, it might be possible in that way to get some definite summation. If—and this method struck me as we were listening intently to his remarks—if it were possible to surround the light-giving center with some sphere consisting of a film of definite thickness and containing a certain quantity of a substance to be acted upon by the light, it would be possible by superposing those films to get, I imagine, what would be the summation of the chemical actions on all the different colors in the spectrum, from the dark rays up to those of highest incandescence. In that way, by dissolving out from this film the soluble portions and determining the insoluble matter, it would be possible, by a chemical method, to arrive at the total chemical action on all those films, and in that way make some definite approach to what is the real energy expended by the light. But it is a subject on which I think we can all say with Goethe, in his dying moments, "We need light—more light."

PROF. NICHOLS: I think I can perhaps make the last point a little clearer. The slide did not quite do its duty there, I think, in bringing out the relationship between the various wave lengths of radiation of four lamps, all of which gave the same candle power, and from that I think I can indicate to you the line along which I would suggest a change of standard. I will take a piece of chalk and draw a diagram which, perhaps, will be a little clearer. Suppose this (illustrating) is the spectrum leading in here. The spectrum is assumed to be of unit intensity throughout. This is the yellow (indicating); here is the red; out here is green, blue, and then violet, which is the limit of the spectrum. Now, if you have a lamp of the same type of carbon, we will say—to illuminate all these questions that Dr. Moses suggested as to different carbons—this state of incandescence is that which corresponds to a 16 candle power lamp of to-day. Take this same lamp and run it at a temperature which corresponds to 4 candle power to-day, and make that lamp large enough so that the photometer says it gives 16 candles, we find a curve like that which I had in my diagram. Here are two lamps—one 16 and the other 4 candle power, and the photometer says that they are the same, but they are not the same either in total amount of energy, as one of my tables showed you, or in luminous effect; and if we run that on to 28 candles we find the red very much weaker and the blue, correspondingly, much stronger. And there are three lamps, all of which the photometer says gives 16 candles, and yet they vary in total luminous energy and in total light-giving value as measured by the luminosity. At any rate, for a single type of carbon, [illegible] certain [illegible] and which give the same value by the Bunsen photometer. In [illegible] this error amounts to 10 per cent. As between the incandescent [illegible] 16 candle and the [illegible] tween candle power and luminosity is [illegible]. When we come to compare candle power with daylight, one is half as good again as the other, and the ratio is 4 [illegible]. That is, a man who would give us 16 candles of a light like daylight would be giving us practically half as much again as he would give us with 24 candles. If a man gives us candle power for candle power of light of the quality of commercial arc light, as 5 to 4, 16 candles of his light are worth 20 of the 16 candles of the incandescent lamps. He who brings his incandescent lamp to a state which corresponds to 50 candles gives us about 10 per cent. more, measured according to the luminosity, and yet we still are satisfied with the candle as our measurement of the performance of lamps.

JOSEPH WETZLER: Prof. Nichols has outlined in a very good suggestion the method which he would pursue to get at the correct method of measuring the candle power of the lamp, and his method would consist in obtaining the radiating surface of the filament and its temperature. I would like to ask if he has attempted any practical way of carrying that out. Naturally it would seem that the determination of the radiating area of a filament would be easy to accomplish, knowing its size and the contour of its surface, and then would come the question of the temperature of the filament. It strikes me that if we knew the rate of variation for any particular carbon, the rate of variation of resistance for the increase in temperature, that that might be comparatively easily accomplished. I would like to know if Prof. Nichols has worked in that direction. We would have merely to measure the resistance of the carbon by a method similar to that of the Siemens pyrometer and we could obtain its temperature, and then, having the temperature and the area, we could get at the value which he suggests.

PROF. NICHOLS: I would say, in reply to Mr. Wetzler's suggestion, that I have been very much discouraged in attempting that, on account of some very singular results which Prof. Anthony obtained some years ago, and which I think he reported to the institute at that time, in the matter of the behavior of incandescent lamp carbons as to resistance of high temperatures. Suppose this (illustrating) were the curve along which the resistance was falling off; if we raise the temperature here and the resistance here, we should expect it to go on falling off according to a well defined law; but in their experiments they came across a number of lamps in which this turned upon them, and there (indicating) you would have a very high temperature and a low temperature. The resistance would be the same. Phenomena of that kind rather deterred me from that method of getting at the temperature of the carbon. But I think there is a hope of getting an optical method—an instrument by which you can look directly at the light and see what is its temperature in degrees centigrade. I think it would be premature to speak of that now, but possibly at some future meeting I may be able to report progress on it.

DR. MOSES: Mr. Upton, I am sure, will be able to answer some of these questions for us. In the manufacture of carbons, for instance, from bamboo, in which he perhaps has had more experience than any other living man, the carbons are manufactured of certain dimensions, that is of cross-section and of length. They are then submitted to approximately a definite temperature, but it is found that they vary considerably in their resistances. Nevertheless, being of the same dimensions and the carbon, when rendered incandescent, being brought up to certain definite temperatures for definite amounts of current, irrespective of the resistances in the beginning, it would seem that when definite amounts of current were passing, that in spite of this variation in resistance you would finally get the same amount of light, having these dimensions and the same material to act upon, and the same temperatures ultimately; the temperature in this case being brought about by the current. Now, I hope Mr. Upton will tell us about what would be the variations in carbons when of the same dimensions, when any given lot of them are put into lamps, would there be a variation of as much as 20 ohms?

MR. UPTON: The ohms vary, of course, from accident. The one constant is the candles per horse power.

DR. MOSES: But a definite fact is the amount of current that you allow to pass through them in testing them for their illuminating power. If you were to allow a definite amount of current of watts to pass through those lamps, would you not approximately get the same amount of illumination irrespective of the initial variation in resistance? It is a problem which, it seems to me, would interest you. You may have tried it and solved it already.

MR. UPTON: You are stating in a few words a pretty large problem; that is the trouble. Of course the question of the quality of the service of the carbon comes in in a very large degree. That has been shown again and again. The one constant, as I said, is the candles per horse power. The carbons will vary, of course. Referring to what Prof. Nichols says about the falsity of photometer measurements, many of us know that where lamps run a little bright, how much more effect can be gained for certain purposes. A greater effect would be obtained for certain purposes far in excess of the increase of candle power. That has been noticed in store lighting where colors come in, and Prof. Nichols has explained it. There is another point about lighting that was not mentioned, and that is that there is a physical effect of lighting; we used to notice that. The moment you get lighting up to a certain bright- [illegible] whether it [illegible] specify your carbon and specify its carbon [illegible] carbon or gray carbon or polished carbon, and all the [illegible] tion from the same surface in candle, and you cannot take any one; you must take your standard of some one of those. [illegible] quality of the surface that fixes the candle power to a [illegible] degree.

DR. MOSES: But may we not get that [illegible] surface by bringing it to the same high [illegible] definite amount of current and then determining whether those [illegible] furnish at the same amount of [illegible] power consumed, the same amount of light.

MR. UPTON: No. Take a thin [illegible] carbon and bring that up highly and use some of the flashing, and that has changed its quality, but the power that it [illegible] give light will change. There is a constant that runs through incandescent lamps that depend on the surface. Temperature does not fix it, as far as I know. Of course the temperature changes with the cooling effects; but to measure the temperature of the filament itself is a very difficult matter. I do not know how to do it at present.

DR. MOSES: I am reminded of Dr. Draper's experiments—the classical ones—where it was necessary to bring the object up to about 1,000 degrees of temperature before it became visibly luminous. Now, we have got our conversation up to that point, and I hope we shall continue it in order to get the results from it. Nature indicates a very definite chemical composition in her vegetable products. It is true any fiber will vary in different parts of the plant, and there will be a difficulty again; but since Mr. Upton, I believe, is careful to have them all from the same radial distance from the axis of the plant, on that account we may consider that the material is homogeneous and uniform. But when we raise a body to a given temperature, we drive off by distillation those substances that may be distilled off, and if we get a definite amount of temperature entirely irrespective of its composition in the beginning, and put that definite amount of current through a definite parallel-opipedon of carbon, then we will get a definite amount of illumination. Would not all substances of the same cross-section, and hence the same areas—all similar carbons—give exactly the same amount of light? My reason for pressing the question is to determine whether the suggestion of Prof. Nichols may not ultimately be taken as the definite photometric standard. Now the platinum method has obvious disadvantages from experiments which have become classical, made at the laboratory, at which Mr. Upton assisted, where platinum was discovered to be constantly changing its condition in a vacuum, and consequently giving off its surface under the bombardments of the particles combined with some action of the currents, that is not by any means a constant. So that carbon may be a better material than platinum. Nevertheless, they and all other substances do not retain their original conditions; they are varying constantly. So that while it might be as good a method as any, it is scarcely to be hoped that it will be ever taken as a standard. Nevertheless, it is so easy to obtain these standards; they can be so easily renewed, that perhaps it may be ultimately adopted as the standard.

MR. MAILLOUX: The constitution of carbon as it occurs in the incandescent lamp is to a large extent an artificial one, and one which is dependent greatly upon the method of treatment of the lamp, not only as a genus of lamp but as a species, and you may say, for instance, that the value of a carbon filament would depend, other things being equal, on the density of the carbon. No doubt density has some relation to the color of it, and again the color has some relation to the condition of the surface, whether it is granular and whether it is crystaline, and whether it is smooth and polished. Now, all of those things, of course, would have a great influence upon the conditions, and it occurs to me that this point of the density of the carbon will be found to have some weight in the consideration of the problems relating to the efficiency of incandescent lamps, and I have thought so ever since that paper was read by Prof. Anthony, to which Prof. Nichols alluded. He anticipated the very question I was going to speak of. It is this: May it not be that this variation of resistance in the incandescent lamp filament is one which [illegible] being abnormal is perfectly normal and characteristic of the carbon; I mean, of course, carbon in a highly incandescent state. May it not be that the resistance of the carbon is a function of its density, and it varies with the density of carbon as a material, and that this attains a minimum at a certain point. Now, the reason I speak of that is that I am brought to it by a certain analogy with substances which are perfectly familiar to us—electrolytes. I have had considerable experience in electrolysis, and in connection with that kind of work have had to determine the specific resistance of a great many substances and I find that a great many substances—I will not say all, but a large number of chemical substances used in electrolysis have that very peculiar property; there is a point of density which will give the minimum resistance. [illegible] stance [illegible] acid, which is so extensively used [illegible] storage batteries, you find that the [illegible] and that a very small increase of [illegible] when you start with pure water, [illegible]

[illegible] that by the [illegible] have reached [illegible] the resistance [illegible] that the re- [illegible] get the s[illegible] become quite [illegible] a very striking [illegible] Anthony presented before the institute in his paper read at the annual meet- [illegible] of salts—like [illegible] which are [illegible] the same [illegible] curvature, and no doubt they are amenable to one general form of equa- [illegible] to deal with a phenomenon which is entirely normal, and that when we once determine the particular law which would appear to be [illegible] means of meas- [illegible] used in [illegible] at many other con- [illegible] having found an expression for the law which connects the density of the [illegible] resistance in some [illegible] towards the finding of a practical method of gauging the efficiency of incandescent lamps. As I understand it, Prof. Nichols states that the ideal method would be one which would be [illegible] energy from the filament of the incandescent lamp itself, and if that were the case it looks to me as though you must look right there for the [illegible]

Dr. Wheeler: It seems to me that the most important [illegible] when they are actually existing—not to be pre-determined, and for that reason I would like to know if Prof Nichols thinks that the sum of the photometer readings of a light in different [illegible] value

[illegible] we have to multiply the photometer reading in each part of the spectrum by [illegible] of the wave-length, and which expresses the light-producing power of that particular wave-length. I will perhaps illustrate this by means of a curve. Suppose you have a light of this kind (illustrat- [illegible] of energy in the spectrum from the violet to the red, and you take the sum of those wave-lengths right down; taking the integrated value of [illegible] this curve, that is [illegible] as the total luminous energy [illegible] light-giving power The light-giving power varies enormously in different parts. We had some curves which showed the way in which that [illegible] Now, the product of the ordinates of this curve into that will give you the total light-giving power of the spectrum to which this be- [illegible] only it is very minute value so far as light-giving power goes. This yel- [illegible] far as its actual energy is concerned, has value representing several hundred times that of the extreme yellow, and out of the red we get great energy and little light-giving power; and at the end our luminosity ceases. We have to take the product of each wave-length, of the amount of energy into its luminosity as determined by one of the methods described; that is the power which that particular wave-length has in enabling [illegible] take blue light and [illegible] light in the spectrum and bring them to the same brightness, so that to the best of our average judgment we [illegible] bright, then take fine [illegible] read it there and put [illegible] In other words, [illegible] point is [illegible] of no value, practically, for that purpose. He [illegible] distinguish black [illegible] the end of the spectrum which lies toward the red, and the rest might as well be [illegible] that we have for the [illegible] about [illegible] we cannot ex- [illegible] so that I think the [illegible] faster than [illegible] must [illegible] purposes for which [illegible] he light.

[illegible]

most commonly used, but for photography there would, of course, be a call for the shorter lengths of blue rays.

[illegible] thought at different times to photographic methods of measuring light. The fact that I have also dabbled in photography has been rather discouraging. As it is quite well known that ordinary silver salts are more sensitive to the blue and violet rays than to others, and almost wholly unaffected by the dark red rays, that would seem to give us a means of measuring the most desirable rays for colors, namely, the violet rays, [illegible] photographs have been taken in almost absolute darkness to ordinary eyes. In other words, the violet rays past the visible end of the spectrum have the power to affect the sensitive plate, and [illegible] have been taken at night, [illegible] twilight of any kind, it being fairly cloudy, in which the conditions were those of almost absolute darkness. Speaking about the inconsistency of carbon and its varying density and general variety of effects, you can get from apparently uniform treatment and conditions varying results within 100 per cent.

Mr. Mailloux: I would differ with Dr. Moses as to the eye being made the ultimate arbiter of the efficiency of the [illegible] lamp, [illegible] that it will be found possible to measure the energy of the incandescent light by other means. I have great faith in the calorimeter, and I believe strongly in the method which was outlined this evening by Prof Nichols I do not see that there are any physical impossibilities lying in the way of our arriving at such a method by which we can differentiate the different kinds of light, and could get a consumption of the total kinds and find out the law connecting them together. Having done this, then it occurs to me that we could express the efficiency with reference to the properties for which the light is to be used, and that we could have a formula, a sort of modulus, as it were, by means of which the varying conditions of the use of the lamps would be taken into consideration in estimating their particular efficiency.

M. M. Garver: It strikes me that what we want to get at is a practical method of determining the value of a lamp for everyday use. We can use fine methods. We can see what has been determined in regard to the lamps. It amounts mathematically to trying to fix a curve with one point while we want to know three points of that curve at least. If we have some practical method of determining the three points of that curve instead of one, the matter would be solved for all practical purposes. Suppose we select the D line in the spectrum That is practically what is selected now. When we use the candle the other two ends are allowed to go up or down just as they please. Perhaps by a method of pigments or something of that kind the two ends of the illuminating power might be fixed, if we can determine the true pigments to be used to compare with the yellow as well. For instance, in determining the illuminating power, instead of selecting a white glass, select two others and give the candle power through three instead of one

The Chairman: I think we appreciate our own ignorance in dealing with such a subject. It is remarkable how far in advance our own speculations and ideas of the subject are of the ideas which are ordinarily entertained by the public, and while listening to the discussion this evening as to candle power, I was reminded of an incident that occurred last week in Bristol, Penn, where one of the large drugstores of the town was illuminated by candles at the time of the starting of the incandescent lamp. The druggist had heard that the incandescent lamps were of 16 candle, and, in order to show how poor and insignificant the new illuminant was, he decorated the whole of his window with 16 candles The result of the illumination was not as great a success as he anticipated, and he was overwhelmed with offers of the loan of snuffers on all sides. Although the incandescent lamp compared so favorably with the candles that were shown by the Bristol druggist, I think we have before us a great deal to do with the improving and perfection of our arc and incandescent lamps in order to secure a greater efficiency, and in order to be less wasteful. The lines of one of England's great poets occur to me in that connection. You may remember them; they are those in which Tennyson says

"Our little systems have their day,
They have their day and cease to be,
They are but broken lights of Thee,
And Thou, O Lord, art more than they."

And [illegible] we can get our own broken lights somewhat nearer [illegible] perfection of daylight [illegible] shall have done some [illegible] which [illegible] Of course Tennyson, in [illegible] having their day, did not [illegible] such [illegible] larger systems. At the [illegible] very great [illegible] that [illegible] three or four papers for [illegible] probability we shall have a [illegible] A short [illegible] [illegible] or three other [illegible]

George Cutter's New Departure.

[illegible] He has secure[illegible]

[illegible] articles as will best serve their purposes. He is active and energetic, and possesses excellent business ability, qualifications which ought to insure success in his new venture. He has a host of friends in Chicago, who will wish him the greatest success in this departure For the present Mr. Cutter's headquarters will be at 43 Lakeside building, Chicago.

Certain Phenomena Connected with Imperfect Earth in Telegraph Circuits.

[illegible]

[illegible]

The imputation of bad earth to the gas and water pipe area of a town, and that town a seaport, is sufficiently remarkable; but the presumption of a general earth imperfection in a system of extended water and gas mains, together with the sheathings of three cables running directly into an arm of the sea, may at first sight appear an outrage upon credulity. Due consideration of the experimental evidence renders the conclusion, however, inevitable; and this is tantamount to the assertion that the whole of this system—that is to say, all the land covered by the town, as well as that forming the harbor basin—is composed of substance more or less insulated or insulating.

Mr. Kenelly, speaking of the features of the geology of Nova Scotia, stated that the rocks of the Halifax basin were known experimentally to be non-conductors.

The question then arises, granting that on the above geological considerations the rocky basin of the harbor and foundation of the city form an insulating crust, or one, at least, interposing a decided amount of resistance between the superficial conducting system and the ocean or earth's mass—is the resistance that can be jointly offered by the three cable sheathings and the whole waterway between the cable house and open sea of sufficient magnitude to produce the degree of interference observed?

The answer, which seems to be affirmative, strictly demands a computation of the resistance offered by the entire mass of sea water in the harbor under those conditions. This would be a gigantic problem to solve with any pretence to accordance with nature; but for the purposes of the case such limitations may be admitted as shall greatly simplify the calculation.

In the absence of experimental evidence, it would be difficult to say how far the variable conductivity of the earth's mass would affect the application of this formula. Schwendler's

$$\Omega = \frac{\rho}{\sqrt{2\pi}}\left(\frac{1}{\sqrt{s}} + \frac{1}{\sqrt{s_1}}\right)$$

an equation independent of the distance between the plates) The conductivity of the material composing the

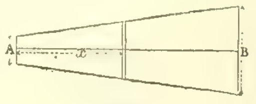

FIG. 13.

earth's crust probably varies considerably in different localities, and is generally not the same as that of the ocean, for example. It might even be assumed that the resistance of the primary rocks is so great as to limit the conducting area almost entirely to the superincumbent stratified formation.

In that case the earth's telegraphic resistance would be more nearly comparable to the resistance between two small distant electrodes imbedded in the surface of an indefinitely extended sheet of uniform thickness and conductivity. On this supposition, let d be the depth of the earth's conducting crust, assumed to be uniform then the resistance, Ω, between two earth plates of active surfaces (s and s_1) would be, approximately,

$$\Omega = \frac{\rho}{\sqrt{2\pi}}\left(\frac{1}{\sqrt{s}} + \frac{1}{\sqrt{s_1}}\right) + \frac{\rho}{\pi d}\log_e\left(\frac{4D}{d}\right)$$

This equation is the same as that of Schwendler last stated, but with the addition of a second term involving D, the distance between the plates; so that on this theory the earth's resistance would increase with the length of the circuit. If submarine cables were sufficiently well insulated, it would be possible to ascertain which of these two theories is nearer to the truth, by measuring the conductor resistances of cables which are laid in duplicate or triplicate between two stations; the difference between the resistance of any pair looped, and the sum of their separate resistances employing the earth circuit, giving, of course, double the earth's resistance between the terminals. It is, however, impossible to decide from present experimental evidence in this way, since not only does the difficulty of accurately measuring these quantities probably increase with the square of the length of cable, owing to leakage and other causes, but also because this second term of the last equation whose existence is in question must in all cases be very small.

Generally speaking, therefore, the experimental evidence may be said to establish the results given by Schwendler's formula, namely, that when the earth plates are separated by any distance great compared with their dimensions, the resistance varies with their active area, and is independent of the [illegible]

Schwendler gives an estimated superior limit of the [illegible] resistance of the earth in India as 3,300 ω, or [illegible] times that of saturated zinc sulphate solution at [illegible]

Returning to the resistance offered by the waterway in the [illegible] entrance of Halifax Harbor, we may suppose a current to be flowing seawards through it and the cable sheathings from the cable house. The lines of flow will permeate [illegible] and the equipotential surfaces may be supposed to form [illegible] successive curves. These surfaces will be [illegible] vertical, and a position has to be assumed for the ultimate one representing the zero poten-

tial, or the surface that may be considered to mark the limit of perfect earth connection. Theoretically, of course, this limit would be far out in the ocean; but it may be arbitrarily assumed that a vertical plane shown on the map by a dotted line connecting the Thrumcap with the Mars Rock buoy represents this boundary, and that the resistance to earth of the ocean mass outside this plane is altogether negligible. The two other dotted lines converging from this base up to the cable house—one skirting Sandwich Point and the other running over Maugher Beach—are intended to represent what may be considered the simple boundaries of an equivalent waterway equal in conductivity to the actual one. The average depth may be taken as 14 fathoms. We have, on this supposition, a mass of sea water resembling a wedge with a blunt point, the breadth of the base being 1.2 knots, the breadth at the apex, say, 5 metres; the length, measured perpendicularly to the base, 4 knots; and the depth, 14 fathoms. (Fig. 13.) Strictly speaking, the equipotential surfaces of flow will be curves convex to the ocean; but the error introduced will not be great if we consider them as planes parallel to the base, or zero surface. Since the fall of potential will take place with equal rapidity through the water and through the sheathings, the resi tance of the latter may be taken into account later and independently.

The resistance actually offered can be estimated from the data of Experiment 11, as follows:

The e. m. f. in the exciting circuit was about 15 volts; the resistance, 66 ω in the cable and earths, and 24 in the battery; total, 90 ω. In the Rye Beach circuit the resistances at the time were, approximately:

Observing mirror................	2,000 ω
Cable conductor..................	5 800
Relay at Rye Beach..............	1,000
Total..........................	8,800 ω

Since the interference current observed in this circuit was, as already mentioned, 5×10^{-6} amperes, the e. m. f. impressed upon the cable due to interference was

$$5 \times 10^{-6} \times 8.8 \times 10^{3} = 0.044 \text{ volts;}$$

and consequently, if x be the required resistance of the general earth connection,

$$x : 90 :: 0.044 : 15,$$

or $$x = 0.26\ \omega,$$

or an actual resistance of a quarter of an ohm. The agreement between the actual and measured values is really much closer than the accuracy of either determination would warrant.

The only experimental results still left unaccounted for are those of Nos. 3, 4, 5 and 6, in all of which the six-mile earth was used either in the exciting or observing circuit; and since Experiment 13 proved this earth plate was outside the limits of the semi-insulated basin, as might be expected from its position on the map, it would be impossible to account for the interference in those cases on the score of a common imperfect earth. Reflection shows, however, that the interference observed would be an indirect necessary consequence of the imperfect earth, since the six mile earth, when connected to either main circuit, forms a cable loop of, say, 10 knots within the limits of the semi-insulated basin, and a slight variation in the potential of the basin is calculated to produce a considerable electrostatic effect on the cable. It has, in fact, been found experimentally that when 1,000 feet of insulated cable core (of similar capacity to that of the cables at Halifax) are coiled in an insulated tank and left in communication with the earth through a mirror instrument, the electrostatic disturbance of the mirror is about equal to that observed in these experiments (3—6) when the potential of the tank is altered by .2 volt. The total charge passing through the mirror in Experiments 3 and 6 would be the resultant effect of the whole system of harbor potential variation on the four knots of cable under observation, except in so far as the capacity of the cable seawards would modify the influence. In Experiments 4 and 5 the interference would, on the other hand, be due to electrostatic charge entering the observing circuit owing to the variation in the harbor potential, electrostatically produced by the loop of exciting cable traversing it. An external average variation of .01 volt in the potential of the basin would suffice to account for the degree of interference observed; and this amount of variation, it is evident, the conditions amply supply. Experiment 13, contrasted with Nos. 9 and 11, showed that the interference observed in cases 3, 4, 5 and 6 was of an electrostatic nature.

The sensitiveness of a cable to external electrostatic influence can be shown experimentally by joining up a mirror galvanometer in circuit with 100 miles of cable and earth. If the distant end be sealed, and laid for two or three feet in an insulated joint trough filled with water, the potential of which is capable of being varied suddenly through 100 volts (from + 50 to — 50), the effect is immediately visible on the galvanometer; and, in fact, simple signals have been transmitted in this way from ship to shore through the coatings of a joint.

The hypothesis of an insulated or semi insulated basin, therefore, satisfactorily explains all the phenomena observed. It accounts, first, for the meteorological disturbances which are observed on the cables, since any alteration of the charge or position of electrified clouds in the vicinity of the harbor may affect the distribution of charge in the cable to an extent that would not be possible if the harbor were in more perfect electrical communication with the ocean or earth's mass, and all the phenomena experimentally observed can be traced either to the direct or indirect effects of this imperfect earth condition—directly by conduction, indirectly by induction.

Assuming, then, that the Lower Cambrian rocks effectively insulate the Halifax basin, it is necessary to suppose that the same effect would be produced at any landing place on the Atlantic shore of Nova Scotia, where these rocks so generally prevail. This is also corroborated by the fact that previously at Torbay some difficulty of the same kind appeared when attempts were originally made to utilize an ordinary earth connection for an overhead Morse [illegible]. The interference [illegible] the cables [illegible] special earth necessary for the land line [illegible] fact that no interference was [illegible] themselves is accounted for by the [illegible] absence of any [illegible] basin at Halifax [illegible].

In Mr. James Graves's paper on earth [illegible] alluded to, mention is made of the [illegible] rock in the neighborhood of the station, and [illegible] supposition that the interference there [illegible] to the same cause.

It is stated that in the Lake Superior [illegible] United States great difficulty has occasionally [illegible] in obtaining efficient earth [illegible] the deficiency has been apparent. I am [illegible] to Prof. Moses G. Farmer for the fact of [illegible] which came under his own notice, where an earth connection, apparently good and well situated, was found [illegible] and measurement showed that its resistance to earth was 12,000 ω. I also owe to him the information that interference, due to imperfect earth, was found [illegible] St. Pierre Miquelon, the Morse signals on the St. Pierre Placentia circuit affecting the Atlantic cable to Brest, and that special measures had to be taken to effect a better earth connection.

Generalizing from these facts, it would seem that there may be difficulty in obtaining good earth at cable stations opened on a shore of primary or metamorphic rock, and that permanent interference beyond remedy by earth connection is possible between cables landed in a basin of such formation; so that if this statement receive confirmation at the hands of the members of this institution, it will be evident that a due regard will be given to geological conditions by electrical engineers among the many incidental considerations that determine their selection of a cable's landing place.

Cable Ciphers.

The methods resorted to by patrons of cable companies to reduce expense are ingenious, to say the least. The New York *Sun*, in a recent article on this subject, quotes an expert on cipher codes as follows: "The cable companies accepted all kinds of business at first, even combinations of letters which spelled nothing. But they soon found that the ingenuity of their merchant patrons enabled them to send almost any message at the cost of a few words, by devising codes wherein each letter stood for a phrase, and wherein even the juxtaposition of letters and numerals, which in themselves had meanings, indicated still other meanings. Of course, this reduced the profits of the cable companies, so they began to make rules. They refused to transmit any combination of letters un'ess it spelled an actual word. Then they limited the number of languages they would transmit. Then they refused to accept words over a certain number of letters in length. Then they refused to take proper names unless the context showed they were a necessary part. All this, of course, was to make it so hard to get up satisfactory and permanent cable codes that the merchant would be compelled for safety's sake to resort to straight out-and-out discourse in framing his messages. But as the difficulties increased, men began to make specialties of devising ingenious codes, and finally the companies had to come out flat-footed and refuse to transmit messages in cipher. Of course this was a severe blow to trade, as a vast quantity of small business could not then be done because the cost of cabling about it cut off most off the eventual profit. Competition finally came to the merchant's aid. New cable lines, seeking business, offered more liberal conditions, and gradually the merchant acquired, as his recognized right, the power of using a cipher code. Still most of the original petty restrictions were adopted by all competitors. Among these were the regulations against proper names. As a matter of fact, in the present state of competition, one is tolerably safe in using proper names and ciphers, for each company is afraid of driving custom to a rival by applying the rule. Consequently, there are any number of small personal or temporary codes agreed upon between man and man to serve a certain immediate purpose, in which names of towns or persons figure as ciphers. But we professional code-makers who compile and print expensive codes for sale to the public carefully avoid infringing even dead letter rules, because we do not know when some big cable company may swallow up a smaller competitor whom one of our patrons patronizes, and screw down the thumbs on some rule, to the disadvantage of our patron and ourselves. Looking over this catalogue here of the cable lines of the world, you will still find a dozen or more companies, chiefly located in the ends of Asia, Africa and Polynesia, who boldly advertise, 'No ciphers permitted.' That means that they have a monopoly of their particular fields, and are working their diamond mines for all they're worth. In no line of business is the advantage of good competition shown more strongly than in cabling. Merchants who deal with far-off countries will tell you that those lands which are reached by only one cable line are as yet practically undiscovered by trade."

The Julien Companies.

The Julien Electric company and the Julien Electric Traction company are, as everybody knows, two New York corporations handling the Julien storage battery. The Julien Electric company furnishes storage batteries for light and stationary power purposes, and their business has been large and successful. Their batteries are in use in connection with electric light plants in various parts of the country, on railroad trains, in private installations, and in connection with power plants. The Julien Electric Traction company devotes, as its name indicates, its attention to electric traction by storage batteries. The company has carefully and systematically worked out the question of electric traction by storage batteries, and now claims to have reached satisfactory results. Their own faith in these claims is made evident by the fact that they have lately

[illegible]

CORRESPONDENCE.

New York Notes.

[illegible]

year to wind up their affairs, and that the position of Phila[illegible] [illegible] $5,000 [illegible] Bernard [illegible] general manager of the Indianapolis Jenney company. How much truth there is in this rumor I cannot say, but it is generally believed.

The result of Mayor Grant's policy in insisting that the electric light companies shall go underground [illegible] the bids for lighting the streets, which are uniformly higher. The electric light companies will have to pay a rent to the subway companies, and they evidently propose to make the city pay a corresponding increase for lighting.

A consolidation of the several Edison companies is very near completion. It will be remembered that this includes a solid money capital of $ 2,[illegible]. It is said that if this combination goes through, as it now seems sure to do, it will preclude all possibility of the Edison company joining any so-called trust. In fact, the Edison company has always maintained an independent position, and has never favored pooling with any other company.

An explosion in the conduit at the intersection of Broadway, Fifth avenue and Twenty-third street, the early part of the week, caused considerable excitement, as the streets were crowded. A loud report was followed by a shower of stones, but fortunately no one was seriously injured. The explosion was caused by a leakage of illuminating gas into the subway, suddenly becoming ignited in some unknown way. Current was not passing through the wires at the time.

The Board of Electrical Control has sent letters to the several gas companies, calling their attention to this explosion, and requesting them to look after all leakages and improper construction of gas pipes. The gas companies, it is stated, have never taken the proper precautions in the construction of their pipe lines.

The te'ephone bill to reduce the price of rent of the telephones in New York is evidently killed. The telephone men are very jubilant, and their rates will undoubtedly remain as heretofore.

It looks as if Mayor Grant's rapid transit bill would come out from the committees of the senate and assembly in such shape that he will not recognize it. The [illegible] killed the cable road, the Arcade road and the extension of the elevated road. Its intention was to [illegible] comprehensive system of rapid transit, but [illegible] its mission will wholly be lost. The cable road people succeeded in getting the bill into the hands of [illegible] committee, and arrangements are now being discussed to combine the Arcade, the cable and the elevated [illegible] in the senate and assembly. If this combination is effected there will be a clear majority in both the houses of the legislature, and the largely amended bill would be passed over the veto of the governor. The question of rapid transit is becoming more serious every day, and a solution of the problem is demanded. Neither Mr. Grant nor anyone else so far seems to have given a satisfactory [illegible]. Some electrical engineer will undoubtedly present a comprehensive system, and we shall wonder that such a system was not devised long ago.

The Western Union's fight in [illegible] way this [illegible] and an injunction [illegible] from its poles has been granted by Judge W[illegible] of the United States Supreme court. It is only temporary, however, as the order to show cause is [illegible]. The [illegible] gives the Western [illegible] right, in case it sees fit, to erect more poles [illegible] more [illegible]. It is claimed by the Western [illegible]

... haste to get ... hat often the poles become ... to carry on the ... their sole intention ... a proper heating ... is not a proper ... make it necessary ... should be renewed once a year. ... Western Union on the ... sed until the law on the subject is determined.

... in the well known ... plaintiff and defendant. The Julien Electric company show their position ... in their favor, and ... of the WESTERN ELECTRICIAN will be of interest to the electrical public.

W. H. T.

Indianapolis, Ind.

... of aldermen at the meeting Monday night failed to concur in the council ... the Brush Electric company for not conforming to the city ordinance. ... this week a resolution ... of the Johnson Street Railway, but failed to pass. The company attempted to ... track on Tennessee street, but was stopped by city ... are opposed to having ... their street.

The officers of the company have about given up the idea of laying track on the North Side, but say they will begin work on the South Side where residents are com... company.

... of the Thomson-Houston Electric company, denies his company has any interest in the Johnson company, and has so notified the council by letter.

At a meeting of the city council and residents of Illinois street ... improvement in the street car service on that street was discussed. The petition circulated, asking the council to pass an ordinance requiring the street car company to put electric motors on that line, was signed by 170 taxpayers. Considerable discussion was had. Many of the citizens favored giving the street car company all they asked, provided they would make the desired improvements. The company's representative stated they were willing to make improvements called for, provided the city would extend their franchise for a long term of years and give them exclusive right to streets. J. A. Bailey, of the Thomson-Houston company, was present ... systems.

M

Louisville, Ky.

... At Covington, Ky., articles of incorporation of the Hughes Manufacturing company were recently left for record with the county clerk. ... Hughes, William Hays and ... stock is $50,000.

The Jenney Electric Light company desires to furnish a ... a representative of that company ... merits of the s...

... the Eastern Kentucky ... that the plant of ... The estimated ... per ... endent, pronounces ...

H

Wichita, Kan.

...

... Cal

candle power each; four masts 150 feet high, carrying each four lamps of 3,000 candle power, and twenty-... masts ... lamp of 3,000 candle power—total ... with an aggregate power of 342,000 candles There are also 3,000 private lamps of 2,000 candle power.

F.

THE ELECTRIC LIGHT.

Las Vegas, N. M., has introduced electric lights.

Fisher, Minn., expects to soon have electric lights.

An electric light plant is being installed in Winchester, Ind.

Morristown, Tenn., has increased its street lighting plant.

The Austin, Minn., electric light plant has been completed.

Au Sable, Mich., will introduce electric lights on its streets.

Sharpsburg, Pa., will establish a 25-light plant for public lighting.

An incandescent electric light plant is being installed in Saginaw, Mich.

Memphis, Tenn., will increase its city electric light plant by 50 or 100 lamps.

The offices in the capitol building at Richmond, Va., are lighted by electricity.

Amherstburg, Canada, has decided to introduce electricity for public lighting.

Seattle, W. T., is considering the advisability of establishing an electric light plant.

The Hayward Electric Light company of San Leandro, Cal., has its plant in operation.

The poles and wires for the electric light plant at Galveston, Tex., are being erected.

An electric light plant is being installed at Bryan, Ohio, and will be in operation June 1st.

One hundred incandescent lamps will be used to light the streets of Galena, Ill., in place of gas.

The Little Rock, Ark., Edison Electric Light company has increased the capacity of its plant.

The National Electric company—capital stock, $200,000—has been formed at San Francisco, Cal.

The Steubenville, W. Va., Electric Light company has been consolidated with the local gas company.

The Sheboygan, Wis., Electric Light company has been organized and granted a franchise in that city.

Anniston, Ala., has decided to adopt the Thomson-Houston company's system for public lighting.

The common council of Evansville, Ind., has ordered twenty-one additional electric lights for streets.

Winchester, Va., Gas Light company has purchased an arc light plant of the Schuyler Electric company.

Thirteen additional electric lights have been ordered by the city council of Lansing, Mich., for street lighting.

Bids for the establishment of an electric light plant at Escanaba, Mich., will be received by the city clerk until May 1st.

The Thomson-Houston company has been awarded the contract for 18 lights of 1,200 candle power each for Anniston, Ala.

The city officials of Oil City, Pa., are investigating several electric light systems with a view of adopting one for public illumination.

A proposition to introduce underground wires in Toronto, is meeting with considerable opposition from the electric light companies of Canada.

The demand for electric light in Decatur, Ala., has led the local gas company to introduce an electric light plant in connection with its gas plant.

The Electric Light company of Marion, Ohio, will shortly increase the arc light plant recently installed by the Schuyler Electric company.

The contracts for public lighting in St. Louis have been approved by the council and assembly, and the city will be properly illuminated after January 1st.

The establishment of an incandescent electric light system in connection with the proposed electric motor railway ... under consideration.

... of ..., Ill., has made a ten years' contract with the local electric light company for ... candle power arc lamps.

The ... State ... asylum at Buffalo, N. Y. ... arc and ... light plant, which will ... tended into the other buildings.

... to have electric lights ... a vote of the ...

... company of San Francisco ... Brush alternating ... set.

... installed a 60-light ... at the station of the ... Pa.

... Electric Light company ... has been ... the city.

... Chicago has shipped a ... to the ... plant complete to

the Braidwood, Ill., mines of the Chicago, Wilmington & Vermillion Coal company; a two-arc light plant to Elmira, N. Y.

The Mount Morris Electric Light company, New York city, has added 200 Schuyler Electric company's lamps, with dynamos and station equipment, to its plant.

The Queen City Electric Light company of Dallas, Tex., has purchased a 500-horse power Corliss engine, several dynamos, and other new machinery to enlarge its plant.

The Fair association of Berne, N. C., has purchased the electric light plant recently installed by the Schuyler Electric company in the Exposition building of the association.

The Colorado Electric works will introduce 100 arc lamps in Denver shortly. Incandescent lamps have heretofore been used for street lighting. They will be placed in the suburbs.

The Fargo, Minn., Gas Light and Coke company and the Fargo Incandescent Light company have been consolidated under the title of the Fargo Gas & Electric company, with a capital stock of $250,000.

A special meeting of the stockholders of the Sun Electric Light company of Chicago has been called for April 16th, for the purpose of submitting a proposition to increase the capital stock of the company from $50,000 to $250,000.

The electric light plant at Colorado Springs, Col., was destroyed by fire March 21st. Colorado City, which was lighted by the same plant, is also in darkness. The work of rebuilding the structure will be pushed ahead rapidly.

The National Electric Light company of San Francisco, Cal., has been incorporated, with a capital stock of $200,000. The directors for the first year are: T. J. Craig, Moses Deutsch, Henry L. Ackerman, H. S. Hunt, Eli C. Meyer.

The Saginaw, Mich., Electric Light & Power company has been organized. It has purchased the plant of the Fort Wayne Jenney company at Saginaw, and will enlarge it. An extensive incandescent plant will be added to the installation.

A dispatch from Harrisburg, Pa., March 25th, says the bill in the legislature regulating the incorporation of electric light companies has been amended, the section giving unqualified rights to string wires and erect poles being stricken from the bill.

Eugene Locks, formerly of the Fort Wayne Jenney Electric Light company, has completed a new system of electric lighting, which he recently tested at Saginaw, Mich., and which he claims is far more economical than the systems now in use.

The Little Rock, Ark., *Gazette*, speaking of the city electric light plant and its cost, says: "The city is getting an incomparably better light for less money than it ever got before; and innovations of this sort are greatly to be desired in municipal government."

The Ellensburgh, Wash. Ter., Electric Light & Power company recently installed a plant which was thought sufficiently large to accommodate the demands of Ellensburgh for two years. It fell short in four months when the capacity was doubled, and still the cry is for more light and a plant that will supply a city of 20,000 people.

A dispatch from Hillsboro, Ohio, says: Hillsboro is having a jubilee over the introduction of the electric light to take the place of gas for lighting the streets. The arc system was adopted, the lights being suspended over the middle of the street, 400 feet apart, each light 2,000-candle power. The illumination of the entire town is complete, the lights extending to the corporation line on every street.

The Westinghouse Electric company report recent installations of their Waterhouse arc lighting plants as follows: Central stations—Benecia, Cal., Electric Light company, 10 lights; Allegheny, Pa., County Light company, 200 lights; Florence, Ala., Electric Light company, 35 lights. Isolated plants—Humboldt Lumber Mill company, North Fork, Cal., 10 lights; Woolf, Son & Thomas, Johnstown, Pa., 20 lights.

The annual meeting of the New England Electric Exchange will be held at the rooms of the Boston Electric club, April 8th, at 2 P. M., when officers for the ensuing year will be chosen. In addition to the regular business there will be a discussion of the "Insurance Requirements for Electric Lighting Stations," and a paper will be read by M. J. Perry of Providence, upon "Economical Steam Plants for Electric Lighting Stations."

A dispatch from Jefferson City, Mo., says: The St. Louis Thomson-Houston Electric Light company filed with the secretary of state affidavit of increase of capital stock from $150,000 to $500,000; also affidavit of change of name to the "United Electric Light company" and increase of the number of directors from five to seven. The new company is the result of a consolidation of the electric light companies in the city of St. Louis.

The Clinton, Ill., *Public* says: The electric light company has a demand for more light than the dynamo and power will furnish. At least forty private residences have made application for the light, and as fast as possible the owner will be accommodated. Seven private residences have been wired during the past two weeks and are now lighted by electricity. It is far superior to any other light for house purposes, is a deal cheaper than gas, and not more expensive than coal oil for the same power of light.

The London *Electrical Review* says: The electricians to the Paris exhibition have devised a method by which, while the coloring of the fountains will be more elaborate than that at the recent Fisheries and other exhibitions, the electric light will be cast upon the water from some hidden source. It will be remembered that at South Kensington the beam of light could be distinctly seen as it was thrown from the

elevated lantern, or lighthouse, upon the fountains and the grounds. The Eiffel tower is to be surmounted, more than a thousand feet up in the air, by an enormous and powerful arc light, which will illumine the exhibition grounds and many miles of the surrounding district. Incandescent lamps will beautify the tower from the base to the summit, and the lighting of the whole of the buildings will be carried out on a scale not previously attempted anywhere.

The Thomson-Houston Electric company, Chicago, reports the following sales: Beardstown, Ill., 100 arc light plant; Falkenberg & Foster, Thirty-first street, Chicagh, avenue, 60 arc light plant for central station lighting; San Francisco, Cal., 50 arc light plant; Madison, Dak., 30 arc lights, and 600 incandescent alternating lights; El Paso Electric company, Colorado Springs, 100 arc light plant. The Citizens' Electric company of Wichita, Kan., has increased its plant by adding a machine of 600-light capacity. This makes the increase since January 1st 1,900 lights capacity.

Electric light was introduced recently into the chain, cable and anchor testing works at Sunderland, Eng. At first seven 300 candle power sunbeam lamps were fitted up, but though giving a good general illumination, they did not prove efficient for the work of examination of chains and anchors under test, and to get the requisite amount of light for this particular work, it was estimated that the pressure would have to be increased from 65 to 80 or 100 volts. This would, of course, have shortened the life of the lamps very considerably, and could not, therefore, be done. In this difficulty J. Hartness, superintendent of the test works, hit upon the device of portab'e lamps fixed to the peaked caps of the workmen, and connected with the overhead mains by their flexible leads. This arrangement has proved successful. The lamps are of 16 candle power only, and it was even found possible to slightly reduce the original voltage, for as the man bends over his work the light is brought quite close to it, and is found to be ample for the purpose. The flexible leads allow each man to move within a radius of about 20 feet, and this distance could be increased if necessary. This is probably the first time that glow lamps have been so used in an English works, although M. Trouve devised some years ago a similar arrangement for use in the Paris sewers. In this case, however, the current was produced by a primary battery carried in a knapsack on the back of the workman, and as a battery of small weight only was admissible, the light was necessarily feeble. The system now in use at Sunderland should prove useful also in other works where the men move only within a confined space. The peak of the cap effectually keeps the glare of the light from the eyes of the worker, and the light flexible lead overhead does not inconvenience him.

Holroyd Smith, in an article in the London *Electrical Engineer* on "Light and Power," says it is necessary to cross the Atlantic to see electric lighting on a large scale. He refers to two or three installations, and then continues in a strain not altogether complimentary. He says: "The praise given to America needs some qualification, and it is only fair to ask, why has the practical application of electricity there so far outpassed the rest of the world? Though it is largely due to the national characteristics of dash and go-ahead, it is not altogether due to these qualities. An American can "calculate" as well as any man; he is not beaten in this particular even by the Hebrew brotherhood—which is, perhaps, the reason why so few of the tribe of Judah and Benjamin reside there—and being able to calculate he finds that, light for light, electricity is cheaper than gas. This applies to America more so than here; first, because gas there costs about 12 shillings a thousand, instead of 2 shillings 6 pence, as here; and secondly, because the authorities will permit a rough-and-ready method of erecting poles and running wires that would not, and ought not, to be countenanced in a civilized country, thus of course cheapening the cost of installation. And further, in England nearly every hamlet has its gas plant, which means so much money sunk. There new towns and districts are springing up every day, and having no capital account to write off there is no hesitation in adopting a new method. Another feature of the American character may be cited as explanatory of the rapid adoption of electricity in that country, viz.: the high cost of labor, and as a result the welcome and encouragement given to men who can devise means of lessening the necessity of employing labor. An inventor in America is looked upon as a valuable man to be encouraged, while here the custom is to shun and suppress and hinder as far as possible, the natural result being that our best men are drawn there, where their efforts are appreciated and rewarded. The American tendency to adopt has resulted in obtaining for them a credit for originality more than they deserve. The public are apt to associate an invention with those who develop and bring it into practical use, so let it be here stated that English scientists owe very little to the Americans, while the American practice is mostly built upon English science. Theories formulated and experimentally proved by English electricians have found no remunerative field here. They have been communicated through the press, or otherwise, to the United States of America, understood, realized, put into practice, made a commercial success, large companies formed, then brought over here and sold to speculators of the Stock Exchange, who, not able to understand, did not appreciate the fundamental truth as propounded by the originator."

THE ELECTRIC MOTOR.

Joliet, Ill., has extended its electric railway.

Marquette, Mich., will have an electric road June 1st.

An electric railroad at Wheeling, W. Va., will soon be operating.

Plans are under consideration for discontinuing the entire horse power service on all the Davenport and Rock Island, Ia., street car lines, and using electric power instead; but whether on the storage or the overhead system is [illegible] determined.

An electric railway will be established between [illegible] and Elmwood.

Work was begun March 22d on the electric street railway at Decatur, I[illegible].

A company has been organized to run cabs by e'ectricity in Washington.

The street car system of Terre Haute will be operated by electric motors.

The Adrian Mich. Street railway will be operated by electricity June 15th.

The New Orleans Electric Light & Power company will equip a short electric line.

The Wayne & Fifth Street Car company, of Dayton, O., is contemplating using electricity.

The Sioux City Street Railway company of Sioux City, Ia., is thinking of adopting electricity.

The Buffalo Street Railway company has secured a franchise for establishing an electric railway.

The People's Street Railway company of Centerville, Ia., is figuring on running its road by electricity.

The electric road at Chattanooga, Tenn., has been completed, and will be ready for operation next week.

The Portland, Ore., Cable Road company is considering the advisability of operating its line by electricity.

The Atlanta & Edgewood Ga. Street Railway company has adopted the Thomson-Houston electric system.

The ordinance granting a franchise for an electric street railroad in Toledo, O., has been passed by the city council.

The Grand Rapids Mich. Street Railroad company is considering the advisability of operating its cars by electricity.

The Houston Tex. Street railroad has passed under control of the Chicago syndicate, and will be operated by electricity.

The Royal Electric company of Peoria, Ill., has recently installed a 30-horse power motor for operating a flouring mill in the city.

The experiments in Seattle, W. T., in propelling cars by electricity have proved successful, and the electric road is now in operation.

The Wheeling, W. Va., Electric railway has been finished to Benwood, a distance of seven miles, and cars are now operated by electricity.

A change in the motive power of the street railway of Terre Haute will probably be made in the near future. An electric system will be substituted.

The Electric Street Railway company at St. Paul, Minn., will erect a one-story building on the main street, with a frontage of 160 feet and a depth of 30 feet

The California Electric company is investigating the advisability of establishing a plant at the headwaters of the Walker River, and transmitting power to the mills and mines of Aurora, Neb.

Work on the new electric plant for the Erie Pa. Street railroad is now in progress. The 150 horse power boilers and the engines are being placed in position, and track is being laid. Extensions to Four-Mile creek and the Head are talked of.

The East Atlanta Land company of Atlanta, Ga., has closed a contract for an electric railway equipment, and the line, it is said, will be in operation within ninety days. The Thomson-Houston company will furnish the motors, cars and power.

The company controlling the horse car lines at Des Moines, Iowa, has been opposing the electric railway company, and the latter has been obliged to appeal to the council to protect its franchise. Property owners along the line of the proposed electric road are unanimous in their support of the electric company.

A coal mining company, known as the Electric Motor company, which has a patent for mining by electricity, will establish a plant at Phillipsburg, Pa., for the mining of an area of ten miles. The plant, as a whole, is to consist of a central dynamo, conducting wires, coal-cutting machine, electric lamps, and motor attachments for hanging the mining cars.

The Sprague Electric Railway & Motor company has recently received a number of large orders for stationary motors, including one to operate a mill in Nebraska by electricity. More than 100 horse power of motors will be employed with the generating station more than three miles away. Several other mills have ordered complete electrical equipments.

Among the railways which have ordered additional equipments of the Sprague company are those at St. Joseph, Harrisburg and Wilmington. These railroads have already ordered one set of additional cars, and this order makes the third order received by the Sprague company in each of these cases. The representatives of these companies have written to the Sprague company expressing satisfaction with the operation of their roads. The East Reading & Black Bear railroad, which has been operating for only two and a half months has proved to be so successful that the directors of the road have ordered an additional number of cars. In St Joseph, Mo., there are two electric railways on the Sprague system, the Union Passenger Electric railway, and the Wyatt Park Electric railway. Both of these companies have ordered an additional number of cars to accommodate the traffic. The additional equipments of the Wyatt Park line calls for four new Sprague cars, and [illegible] ay in [illegible] equipped with motors and batteries, they will weigh about [illegible]

[illegible] will substitute electricity for steam motors. A representative of the company said: "The determination to adopt more rapid [illegible] the line for faster time. The eleven miles of the road constituting the system will be traversed when the improvements are made, in thirty minutes. As to the time [illegible] for the commencement of the work I am not prepared to state, but it will occur in the very near future. I cannot say positively the kind of motor the company will use, but I believe the storage battery is preferable"

THE TELEPHONE.

St. Joseph, Mo., will be connected with Lathrop, Agency Ford, Grover and Plattsburg by telephone shortly.

New Cumberland, W. Va., has established a telephone exchange, and has connection with Claysville, Washington, Wheeling and Pittsburgh.

Telephone subscribers at Albany, N. Y., have been protesting that their neighbors used their telephones more than they did, and the company has issued an order prohibiting the use of the telephones by any one but subscribers.

A movement is on foot to build a telephone line from North Bay to Tacoma, W. T., via Gig Harbor and the narrows. Some difficulty is encountered in crossing the narrows, but the line will probably be completed before the end of the year.

The recent election of the Wisconsin Telephone company resulted as follows: President, Henry C. Payne; vice president, C. H. Haskins; secretary, John D. McLeod; treasurer, F. C. Bigelow; directors, E. H. Broadhead, B. K. Miller, H. C. Payne, C. H. Haskins and George Albee. The directors have re-elected F. E. Parker superintendent. The Wisconsin Telephone company last year strung 329 miles of wire in the state. This year it is proposed to extend the lines from Monroe to Darlington, Mineral Point to Dodgeville and Highland, Lancaster to Platteville, Georgetown to Dubuque, Ia., and Galena, Ill.

The wires of the Hudson River Telephone company at West Berne, N. Y., were cut recently. There was only one instrument in the town, but this was not sufficiently patronized to pay the company to maintain the line. The company notified the people of that place that unless at least the amount of the royalty was guaranteed the company the telephone would be removed. The people did not want the instrument removed, but would not agree to make up the small amount of the royalty, and about two weeks ago the instrument was taken out. Threats had been made before that time that if that action was taken the wires would be cut and the lines rendered useless. This threat was carried out Sunday night, when the wire was cut and about 200 feet of it carried away. The company was notified and a telegram was sent to Schoharie to have the wires replaced. By this piece of rascality between twenty-five and thirty places in Schoharie, Delaware and Otsego counties were temporarily cut off from communication. The line was repaired at once.

THE TELEGRAPH.

A fourth telegraph wire is being stretched between Portland and Ashland, Ore. It is 345 miles long and will cost $63,000.

J. McRobie, manager of the W. U. T. company at San Francisco, has been appointed superintendent of the American District Telegraph company of that city.

In the case of the Great Western Telegraph company against William H. Bush in the Circuit court, Chicago, to recover an assessment of 35 per cent. on an alleged subscription made by defendant in 1869 the jury returned a verdict for defendant. The case will be appealed.

John G. King, manager of the Spalding Telegraph company, has made an application to enter the city of Washington. He says that Washington, Baltimore, Wilmington, Philadelphia, New York, Boston, and other cities will be connected by underground cable, and they will give much more constant, uninterrupted and cheaper service than is possible by overhead wires. The cable will be laid in a six inch cast-iron pipe, one foot below the surface of the ground, and will contain from 75 to 150 copper wires. The necessary stations and turnouts will be put in at various points along the line for the accommodation of other cities.

Speaking of the new telegraph company which is to enter Los Angeles, Cal., the [illegible] says [illegible] anticipate considerable rate cutting. It says [illegible]

geles is to have another telegraph line running from its [illegible] States, Canada and Tu[illegible] [illegible] from here to San Fran[illegible] [illegible] to Washington Ter[illegible] [illegible] the Canadian Pacific [illegible] and thence to Europe. [illegible] communication with [illegible] the Western Union [illegible] reporter, in conversation [illegible] telegraph circles, was told [illegible] Los Angeles there will be some tall cutting of rates. I am told that the rates from [illegible] be reduced one half.'"

Personal Paragraphs.

[illegible] has been appointed [illegible] Motor company.

[illegible] agent of the C. & C. [illegible] agent for isolated [illegible] company.

[illegible] W[illegible] charge of the Edison interests in Omaha, was in Chicago last week on his way to Cincinnati. Mr. Koster will hereafter represent the Edison company in the Ohio valley.

[illegible] at Concert hall, Omaha, April 12th, on "Sources and Characteristics of Electricity with its Modern Applications." The lecture will be illustrated [illegible] experiments.

Telephone Stock Quotations.

[illegible] 14 LaSalle street, Chicago, reports the following quotations of telephone stocks:

[illegible]	300	305
[illegible]	50	51
[illegible]	81	82
[illegible]	31	33
[illegible]	39	40
Rocky Mountain Bell	40	41
[illegible]	67	69
[illegible]	116	117
[illegible]	150	153
[illegible]	22	25
[illegible]	69	70

Business Mention.

Okonite wire is specified for all the wiring for electric bells and messenger calls in the Auditorium building, Chicago. [illegible] will be required.

The Electrical Supply company has been given the exclusive western agency of the Fowler speed indicator, [illegible] dynamo work.

The Central Electric company of Chicago, is putting on the market the Boston ceiling button and rosette. The company has just received a small hand Holtz machine for classroom use and for experimental uses. It is inexpensive [illegible]

Among recent sales of the Sioux City Engine Works are [illegible] for Yankton, Dak.; 9x14 slide valve for Reed Springs, Mo.; a 20x42 Corliss for Des Moines Electric Street Railway company; 14x36 Corliss for Andrews & Floyd, Sioux City; 12x24 Corliss for [illegible] Madison, Dak.; 7x14 slide valve for Barrett Bros.' stone yard, Sioux City; also a large boiler for the Sioux City Pottery company. The [illegible] their machine shops [illegible] until 9 o'clock every [illegible] and improved ma[illegible] demands of their [illegible]

A letter from the United Engineering company of Lon[illegible] those who are [illegible] bearing on [illegible] al distribution by means of transformers, and the [illegible] Messrs. Ferranti at [illegible] of 1877 is now [illegible] em. The holders of this im[illegible] Electrical Engineering com[illegible] electric light com[illegible] ried out. The [illegible]

[illegible] Patents.

[illegible]

2. In a [illegible] for electric railroads, the combination [illegible] conducting strip enlarged or [illegible] and a contact shoe pivoted thereto."

400,050. Annunciator. Ira S. Bunker, Nevada, Mo.

400,[illegible]. Galvanic Battery. Carl [illegible] Kammeyer, Chicago, Ill.

The heads of some of the elements are inclosed within the metal of the cover, and connected by the portion of the metal of the cover about the heads of the elements.

400,126. Galvanic Battery. Frank Shaw, New York, N. Y.

The negative element consists of two concentric cylinders attached together at one end.

400,130. Dynamo Electric Machine. William L. Silvey, Cincinnati, Ohio.

The first claim reads:

"A field-magnet for dynamo electric machines, cast in a single piece and broken into two or more parts by means of wedges driven into holes where the divisions are desired, for the purpose of facilitating the winding of the coils of wire thereon."

400,139. Switch Stand for Dynamo Stations. Robert E. Stewart, Dallas, Tex.

400,141. Telegraphic Transmitter. Ross C. Stone, New York, N. Y.

The second claim is given:

"The combination, with an insulated metallic plate, of an integral non-conducting covering extending over the surface of said plate, said covering having apertures representing the characters of a signal, and separate guiding grooves proximate to said apertures."

400,179. Electric Railway Contact. Edward M. Bentley, New York, N. Y.

The last claim follows:

"25. The combination, in an electrically propelled vehicle, of a transverse mechanical guide extending beyond the car wheel, and a contact device movable along said guide, of a conductor slide terminating at a point between the wheels, a traveler therefor, and a flexible electrical connection between the traveler and contact device."

400,180. Electric Railway Plow. Edward M. Bentley, New York, N. Y.

The last claim is as follows:

"20. The combination of the conduit and inclosed conductor with the plow, a mechanical connection permitting transverse movement of the plow, and an extensible spring electrical connection between the plow and vehicle."

400,181. Method of Detecting Grounds in an Electric Distributing System. Edward M. Bentley, New York, N. Y.

The method consists in first sending an irregular current through the grounded conductor, then moving along in proximity thereto an induction coil connected to an accessible indicator and noting on the indicator the variation in the induced current caused by the coil passing the grounded point.

400,182. Fault Detector for Electric Railways. Edward M. Bentley, New York, N. Y.

A plurality of line conductors inclosed in a common conduit, and located at intervals apart, are used in combination with an induction coil movable in the conduit into proximity with any desired one of the conductors, the induction coil controlling an indicator.

400,198. Electric Arc Lamp. Edgar A. Edwards, Cincinnati, Ohio.

Claim 1 reads: "In a focusing arc lamp, the combination, with a movable or adjustable electrode and mechanism to adjust the same, of a non-consuming electrode and a guide embracing the movable electrode at or near the tip thereof."

400,214. Electric Lighting System. William L. Horne, Meriden, Conn.

The invention comprises an air-tight inclosing case for an arc lamp, an exhaust pipe opening into and communicating with said case, and a valve above the opening within the case.

400,215. Galvanic Battery. Alexander Imschenetzky, St. Petersburg, Russia.

400,224. Voltaic Battery. Isidor Kitsee, Cincinnati, Ohio.

[illegible]

"In a voltaic battery cell, [illegible] combination, a solution of chloride of ammonia, or of chloride of soda, or of other chloride, bisulphate of mercury, and positive and negative element immersed in the solution."

[illegible] Voltaic Battery. Isidor Kitsee, Cincinnati, Ohio.

"[illegible] voltaic battery, in combination a [illegible] positive and negative elements [illegible] connected therewith by [illegible] discharge pipe leading [illegible] which the battery fluid [illegible] battery [illegible] discharge [illegible] and with the battery [illegible] cell of the same."

[illegible] Isidor Kitsee, Cincinnati, [illegible]

[illegible] battery consisting of [illegible] electrolyte or to [illegible] other element [illegible]

[illegible] Isidor Kitsee, Cincinnati, [illegible]

"In a voltaic battery cell, in combination, an iron electrode immersed in a battery fluid containing chlorate of sodium or a chlorate of other material, and a carbon electrode immersed in a battery fluid containing sulphuric acid."

400,235. Galvanic Battery. Eduard Liebert and Sally A. Rosenthal, Berlin, Germany.

The existing liquid consists of one hundred parts, by weight, of water, from twelve to twenty parts of sulphate of zinc, from one to four parts of sulphuric acid, and from two to ten parts of perchloride of mercury or protochloride of mercury.

400,239. Electric Burglar Alarm. Joseph V. McKinney, New Wilmington, Pa.

400,245. Throttle Valve Controller. Gustave S. Neu, New York, N. Y.

400,264. Automatic Grounding Device. Elmer A. Sperry, Chicago, Ill.

Claim 1 follows: "The combination of a main normally closed metallic circuit with an electro magnet therein, a ground circuit and contact, a pivoted armature lever adapted to move between such contact, and such magnet, such armature held to such magnet by influence of the current passing over the main line, and a motion-retarding device connected with such armature lever, which permits the same to leave the magnet and engage the contact only when the current is discontinued for a considerable period of time."

400,274. Friction Gear for Electric Motors. Charles J. Van Depoele, Lynn, Mass.

400,283. Time Recorder. Harvey R. Adams, Marseilles, Ill.

400,300. Electric Conduit. Henry A. Chase, Boston, Mass.

400,304. Hotel Call. Edward J. Colby, Chicago, Ill.

400,308. Method of Constructing Underground Conduits.

The invention consists in providing a flexible casing composed of non conducting material having a core of water, air, sand, sawdust, or the like, and temporarily hermetically closed at both ends, in building the conduit material around said casing, and subsequently freeing the core therefrom.

400,311. Electric Motor. Etna H. Davis and Reuben Westervelt, Elmira, N. Y.

400,312. Thermostat. Etna H. Davis and Reuben Westervelt, Elmira, N. Y.

400,315. Regulator for Electric Motors. Robert S. Dobbie, New York, N. Y.

Governor balls operate to open the circuit around high resistance to bring said resistance into circuit until speed is sufficiently decreased.

400,325. Telephone. Noel B. Ginochio, New York, N. Y.

The last claim reads:

"5. In a magneto-telephone, a diaphragm of pyroxyline having magnetic material embedded in one surface."

400,326. Telephone. Noel B. Ginochio, New York, N. Y.

The last claim reads as follows:

"The combination, with an annular compound magnet, of an armature arranged to rotate therein and supported in bearings secured to the sides of the magnet, extension pieces connected to the annular magnet by dovetailed joints having tapering ends, and telephone coils secured to said ends."

400,327. Magneto-Electric Generator. Noel B. Ginochio, New York, N. Y.

The invention consists in a permanent magnet consisting of a number of strands twisted together, each strand consisting of a series of independent steel wires.

400,352. Arc Lamp. William H. Miller, New York, N. Y.

Claim 7 reads: "In an arc lamp wherein one carbon is propelled constantly against a fixed abutment by a spring, the combination, with the carbon-inclosing tube and abutment, of a two-part spring composed of a main and supplementary part, the latter being adjacent to the carbon and constituting a removable section of the propelling spring."

400,336. Process of Hardening Steel. Frederick Sedgwick, Oak Park, Ill.

The invention consists in first heating the steel, then immersing it in a bath of cooling liquid, and simultaneously passing an electric current through it and the liquid.

400,375. Pneumatic Flexible Slot Conduit for Electric Railway Conductors. Charles J. Van Depoele, Lynn, Mass.

400,378. Incandescent Electric Lamp. Edward Weston, Newark, N. J.

The points of the connecting wires are placed in an electro plating bath until a metallic coating of the desired thickness is deposited on said joints.

400,395. Electric Distribution by Storage Batteries. Stanley C. C. Currie, Philadelphia, Pa.

The fourth claim is given:

"In a system of electrical distribution, the combination, with the main line conductor, an electric generator, an accumulator, a manually operated switch, and an electro-magnetically operated switch and a shunt line connecting the two switches, of an automatic circuit breaker arranged in said shunt line and constructed and arranged to break the shunt circuit, and thereby cause the switches therein to simultaneously cut out the generator and the accumulator from the main line circuit."

400,401. Secondary Battery. Rudolph M. Hunter, Philadelphia, Pa.

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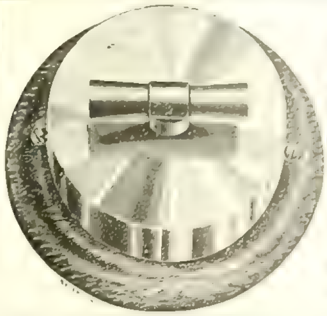

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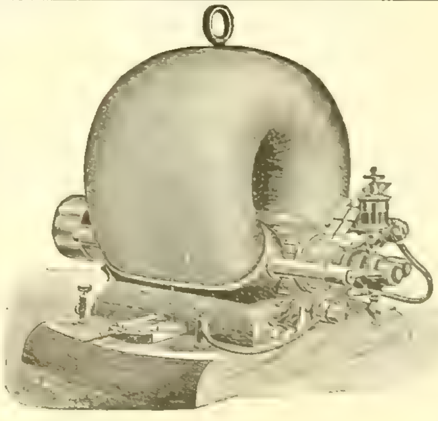

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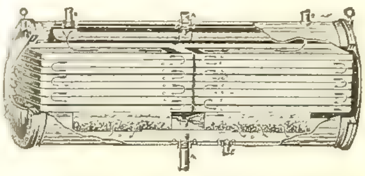

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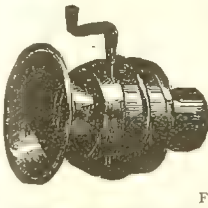

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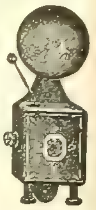

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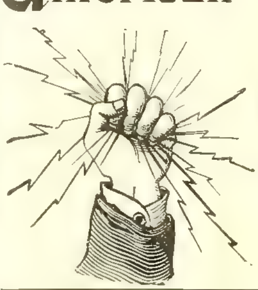

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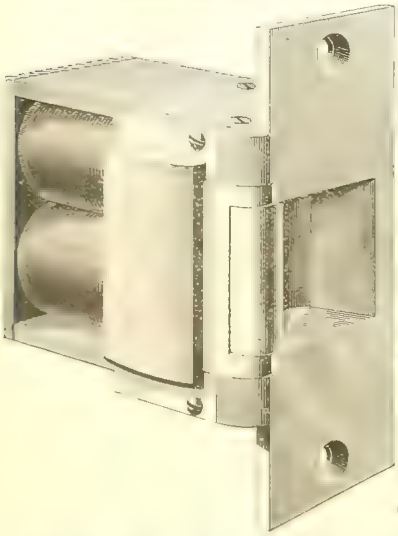

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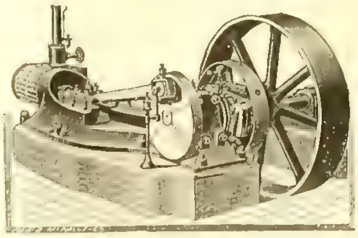

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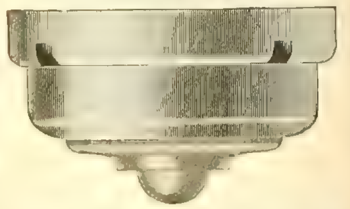

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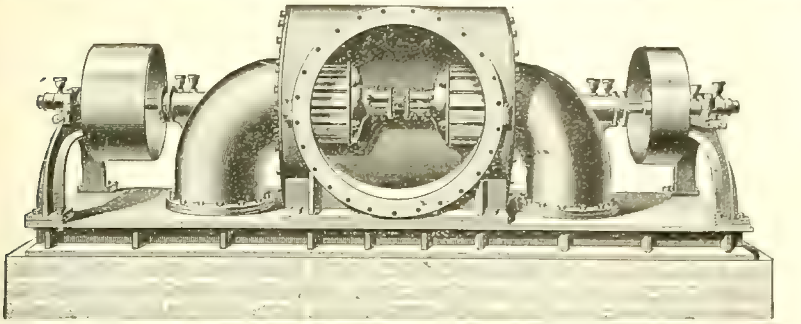

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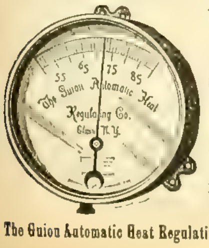

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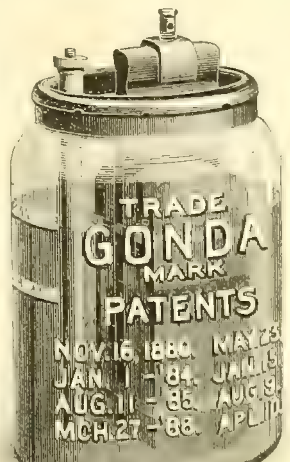

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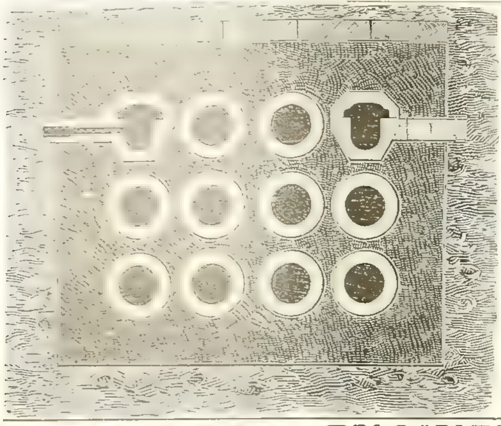

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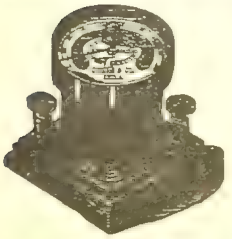

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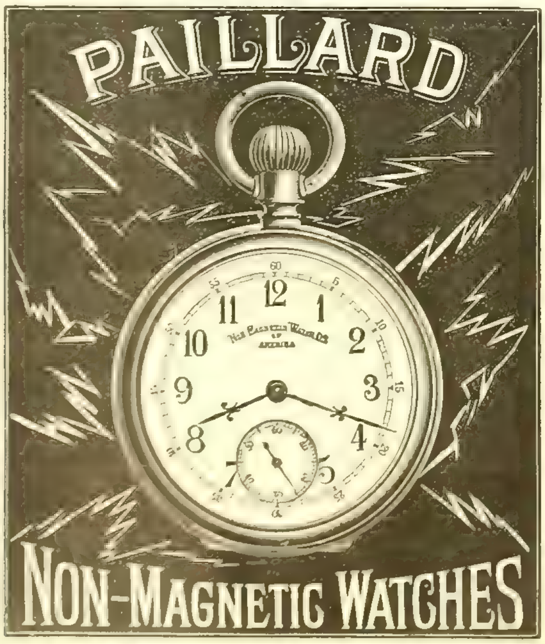

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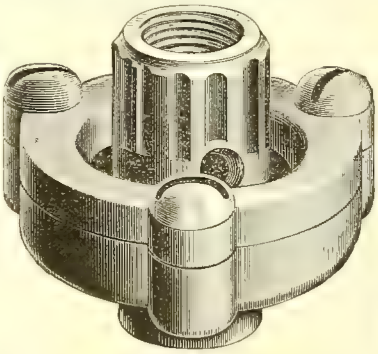

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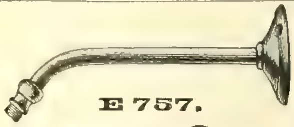

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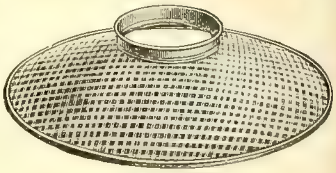

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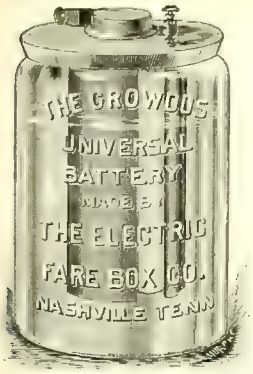

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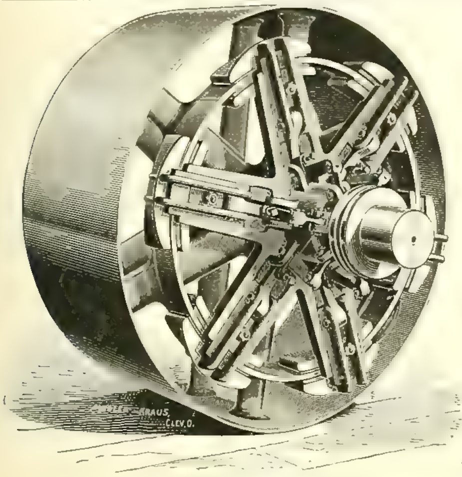
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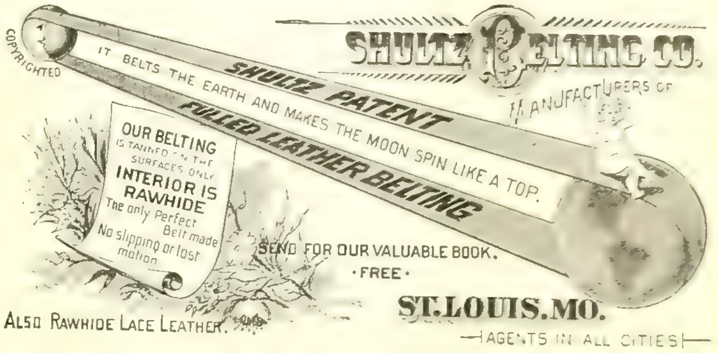

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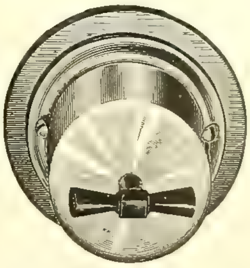

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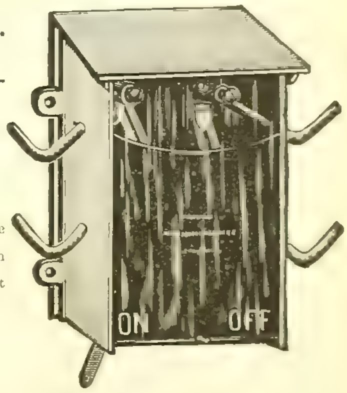

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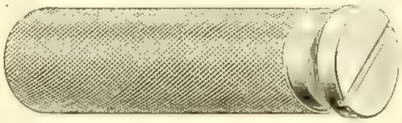

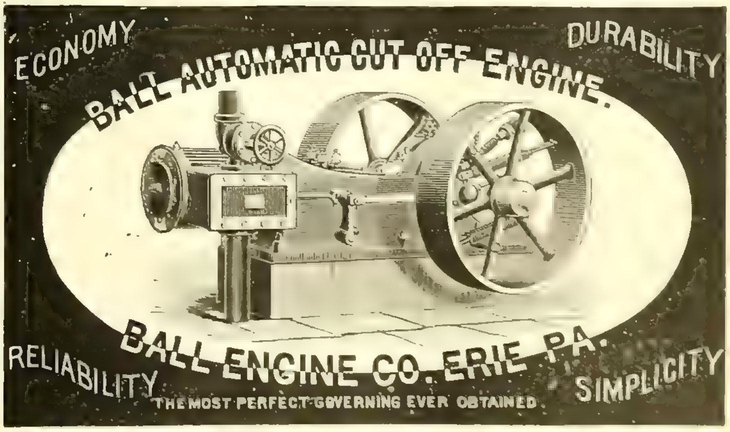

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RECENT STORAGE BATTERY DECISION.

Synopsis of the Court's Decision in Judge Coxe's Own Words.

Some controversy having arisen as to the extent of the recent decision of Judge Coxe in the important case of The Electrical Accumulator Company against The Julien Electric Company, we give below so much of the text of the opinion as is necessary to enable the reader to determine just what the Judge actually decided As the opinion covers in all 57 pages of type-written matter, we are unable to give it in full.

UNITED STATES CIRCUIT COURT.
Southern District of New York.

The Electrical Accumulator Company
vs.
The Julien Electric Company and William Bracken. } ***In Equity.***

FREDERICK H. BETTS for the Complainants.

THOMAS W. OSBORN and HORACE M. RUGGLES for the Defendants.

COXE, *J.:*

"This is an action for the infringement of four letters patent, owned by the complainants, for an improvement in secondary electrical batteries. One of these, No. 266,262, granted to Shaw and Rogers, October 17, 1882, has been withdrawn from the consideration of the Court. The three in controversy are No. 252,002, granted January 3, 1882, to Camille Alphonse Faurè, and Nos. 312,599 and 318,828, granted, respectively, February 17 and May 26, 1885, to Joseph Wilson Swan."

The Court, after discussing the general nature of the improvements described in the patent of Faure, said: "The claims in controversy (in Faure Patent No. 252,002) are the first and the fourth."

After a summary statement of the defenses presented by the answer of The Julien Electric Company, the Court says:

"In construing the first claim it should be remembered that it is limited to an improvement upon the well known batteries of Gaston Plantè, who was the creator of practical secondary batteries. The art began with him."

The Court next proceeds to discuss the proper construction of the first claim, and after defining its scope considers the proofs of anticipation and prior use offered by the defendant.

"It therefore becomes apparent that the combination of the first claim, construed as it must be construed under the loose and inaccurate language of the specification, is anticipated in every form in which the active layer can be applied, save one—namely, in the form, of a *paint, paste or cement.* The question now to be considered is can the *patent* be *saved to this extent?* *The application in the form of a paint, paste or cement was the real invention which Faure made.*"

* * * *

"The proof establishes two propositions with equal clearness. First, Faure was the inventor of a secondary battery electrode coated in the manner stated; and, second, he was not the *inventor of an electrode otherwise coated.*"

"If, by means of a disclaimer, the patent can be restricted to the actual invention, this course should, in fairness, be adopted."

* * * *

"What he did not invent was an electrode in a secondary battery coated with a soluble layer of active material, neither did he invent an electrode on which the active material is applied by 'galvanic action or chemical precipitation or otherwise.'

* * * *No one will infringe unless he constructs his battery in the one way to which the patent will be confined.*"

* * * *

"After giving the subject the most careful consideration, it is thought that Faure was the originator of the invention just described, and that it would be unjust to him to declare the patent wholly void if he is willing to restrict it to what is lawfully his own."

The Court immediately proceeds to discuss the fourth claim of Faure's patent:

"The fourth claim, if construed to cover the defendants' structure, is void for want of novelty.

* * * It is clear that a construction of the claim which is broad enough to cover the defendants' battery renders the claim invalid.

* * *

* * * A limited construction can, however, be given the claim, which will render it valid."

"The Court then proceeds to discuss the construction of the fourth claim, proposed by the council of The Julien Electric Company, and says:

"In view of these facts, and because the patentee, in effect, disclaimed the construction sought to be placed upon the claim by the complainant, it would seem that the defendants' construction has much in reason and authority to support it, and is the more rational of the two.

"So construed, the defendants do not infringe the claim."

The Court next proceeds to consider the first patent granted to Swan, No. 312,599, and after discussing the construction of the patent and the proofs offered by The Julien Electric Company showing the state of the art and prior use of the invention by other parties, concludes as follows:

"Upon this evidence, therefore, the *first Swan patent must be declared invalid.*"

The Court next proceeds to discuss the second patent granted to Swan, No. 318,828, and after comparing the same with Swan's first patent, says:

"Even if the second patent can be distinguished from the first in the particular stated by the experts, it is entirely clear that the difference pointed out is wholly insufficient to sustain invention. After the first patent, there was absolutely no room for the second patent. * * Swan describes no invention in the first patent which is not covered by the claim of that patent. What is not claimed is not patentable."

"The decision concludes with the following language:

"It follows, therefore, that the complainants, upon filing a disclaimer, limiting the first claim of the Faure patent to an electrode of a secondary battery to which the active layer is applied in the form of a paint, paste or cement, insoluble in the electrolytic liquid, are entitled to a decree for an injunction and an accounting upon the claim as thus limited, but without costs."

It will appear from the foregoing opinion, that no decree has been awarded to the complainants for any relief whatever, nor has any one of the patents been sustained; but on the contrary every claim in controversy is decided to be invalid (except one which is held not to be infringed).

The Court has merely given leave to the Accumulator Company to file in the office of the Commissioner of Patents a disclaimer limiting the first claim of Faure's patent in the manner specified, and decided that, if this condition be complied with, the complainants may have a decree for an injunction restraining infringement of this claim, thus narrowly limited.

The filing of such a disclaimer will operate as a complete abandonment of Faure's chief pretensions, and will limit his patent to a device which the Julien Company does not use and does not desire to use.

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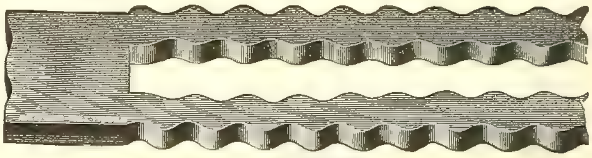

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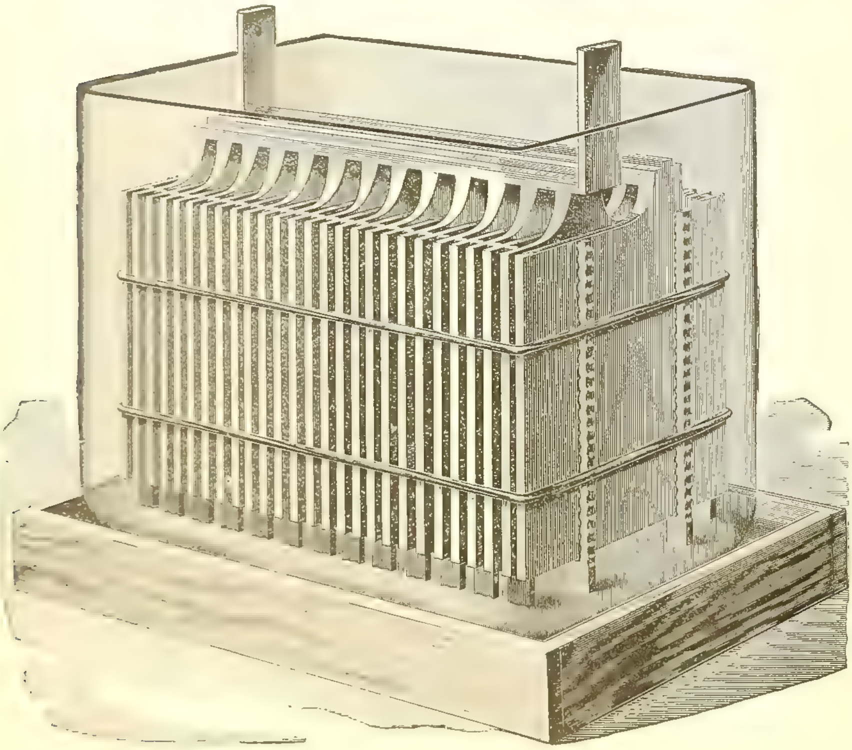

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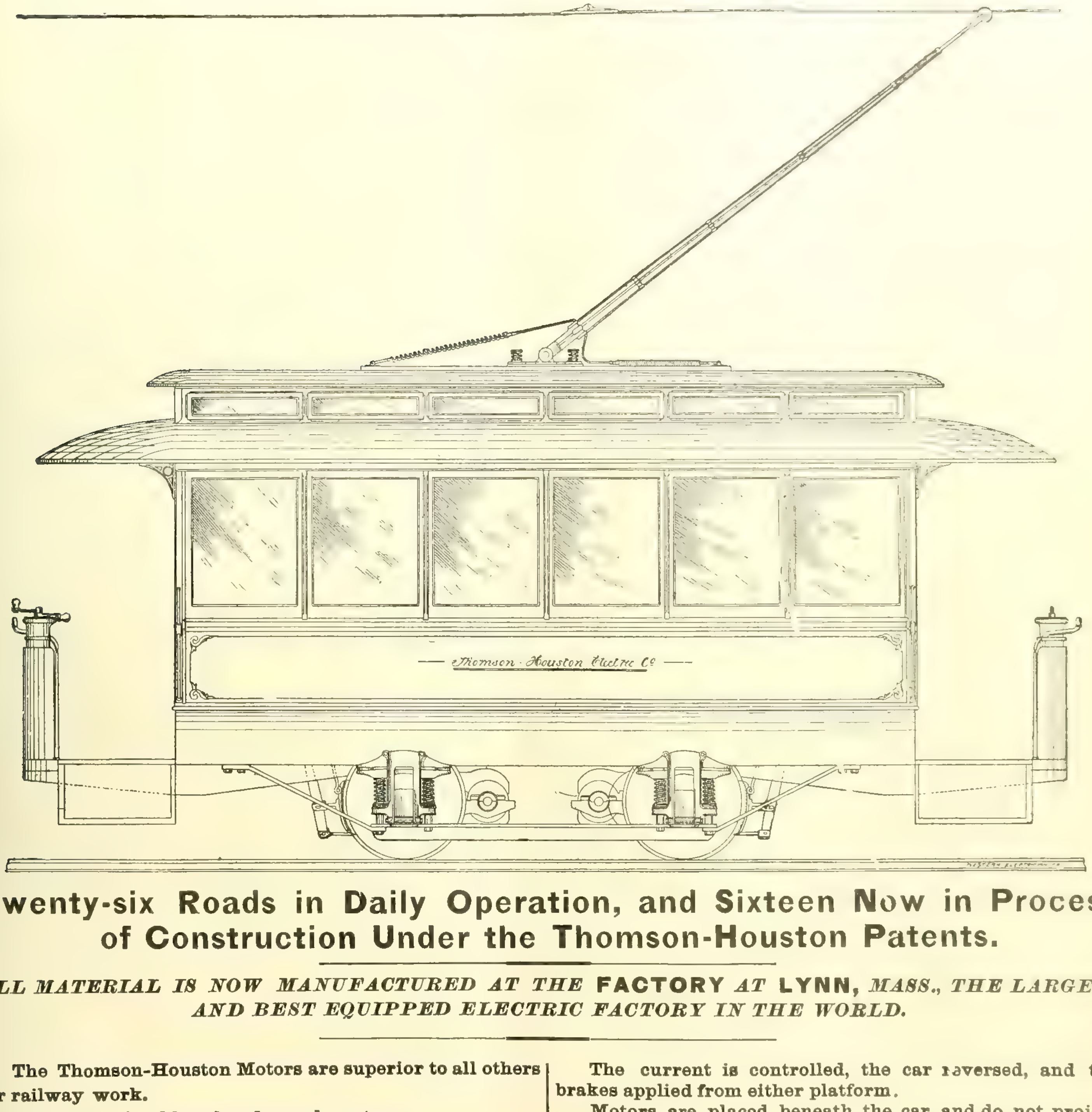

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When Webster's unabridged is the only limit for assertions—when facts are disregarded and the limit of words is the only limit for claims made [illegible]ertisements, we are, in claiming the largest, best assorted and lowest priced stock of electrical goods to be found in this or any other country [illegible]—when we come to facts—when we show you through our stock and enable you to judge for yourself, we think you will agree [illegible] that as far as a large and well assorted stock is concerned, we are without competitors, and that if the claims of quality, low prices, prompt [illegible] made by some of our friends, do not "pan out" better than their claims regarding "largest stock," they must be classed, to put it mildly, as "windy," and not apt to bear much fruit.

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[illegible]g a combination of our catalogues on Wires, Cables, Conductor Cords, Metals, Construction, Material, Tools, Test Instruments, etc., [illegible]. This catalogue is well illustrated throughout, describing and pricing everything necessary for the construction, operation, or [illegible]tric light plants; it contains descriptions of many new inventions and improved appliances, and is well worth your [illegible] kindly refer to page or stock number as much as possible, and help us to avoid mistakes or misunder-[illegible]

WE "GET THERE" BY THE GOOD WILL OF OUR FRIENDS,

[illegible] favors. We might liken our friends of the various electric lighting companies to a grand army of progress, [illegible] dark places. Supply wagons are necessary with any army, but the wagons are useless unless the supply [illegible]. We [illegible] to follow the different divisions of *the grand army of progress* up closely and request that they [illegible] attack and manner in which they intend to take the enemy, that we may have necessary supplies [illegible]

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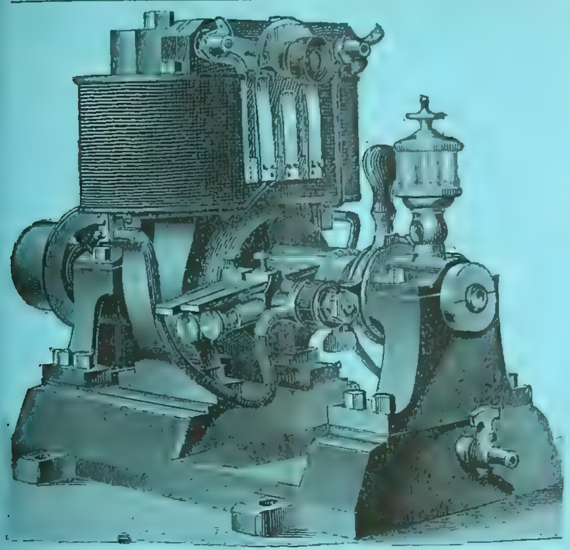

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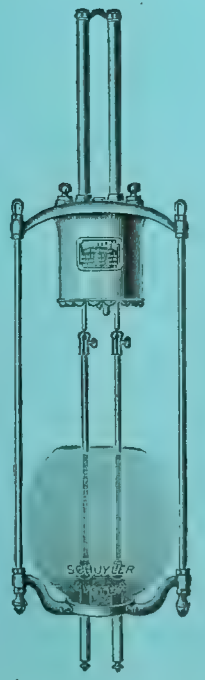

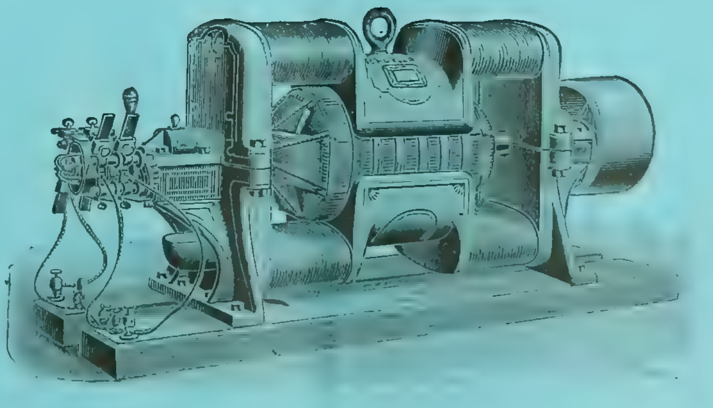

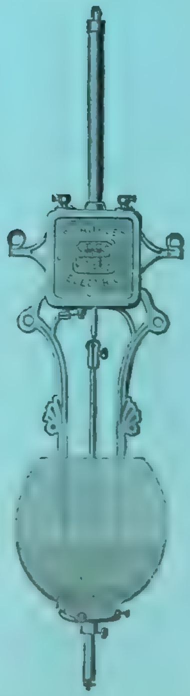

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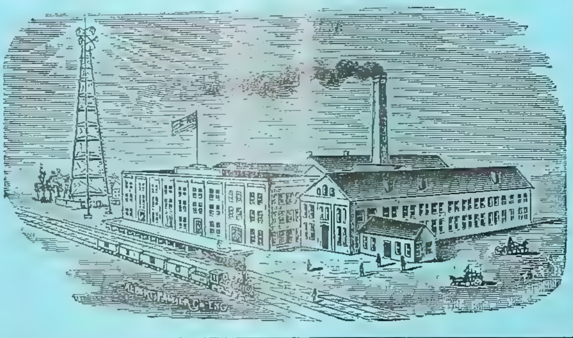

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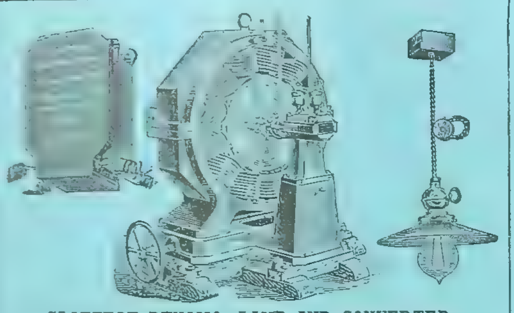

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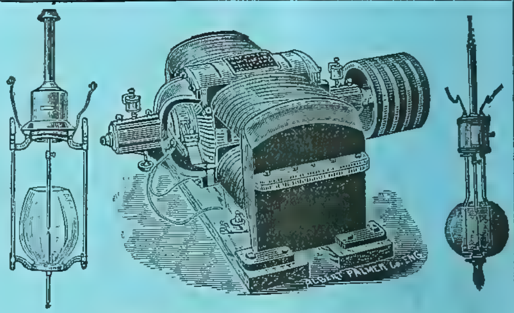

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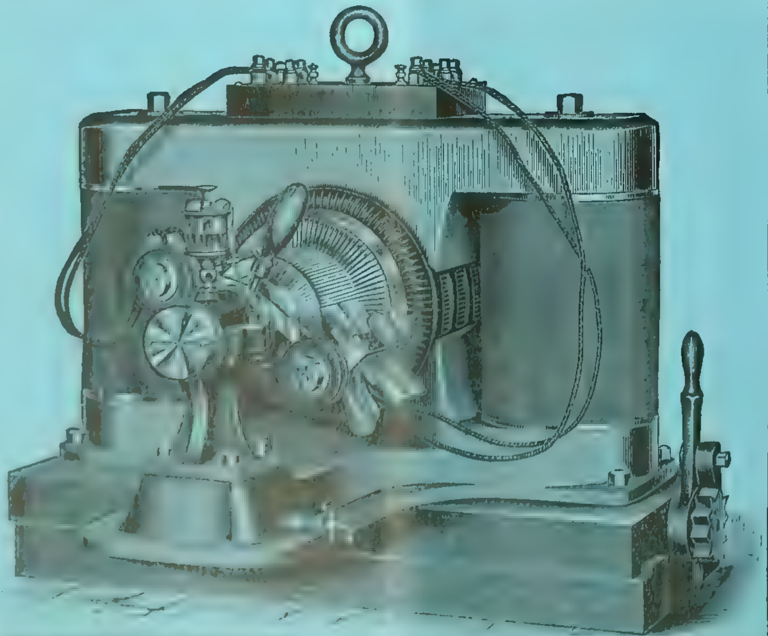

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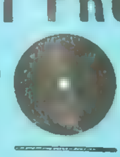

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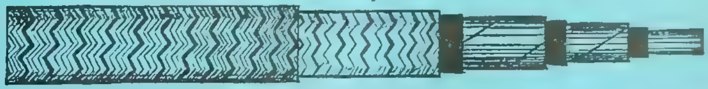

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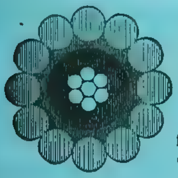

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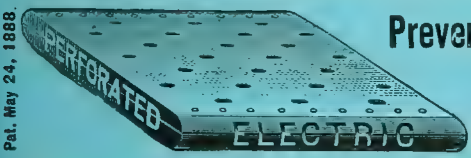

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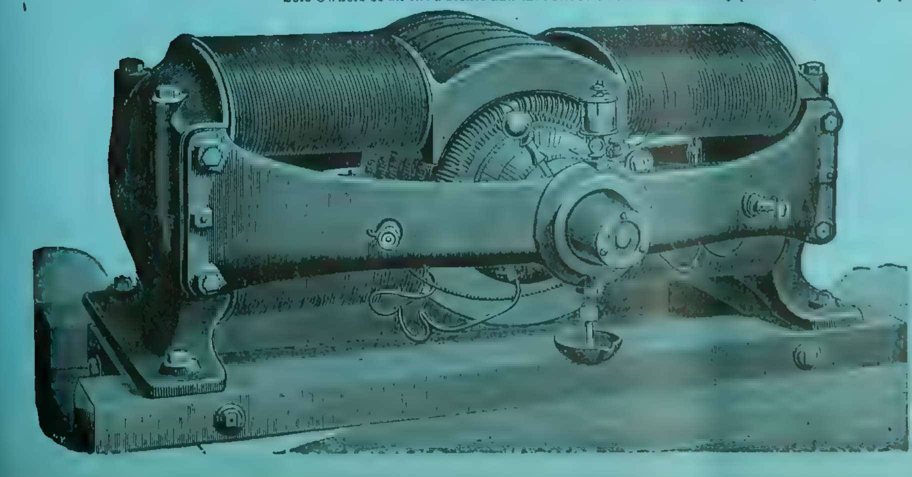

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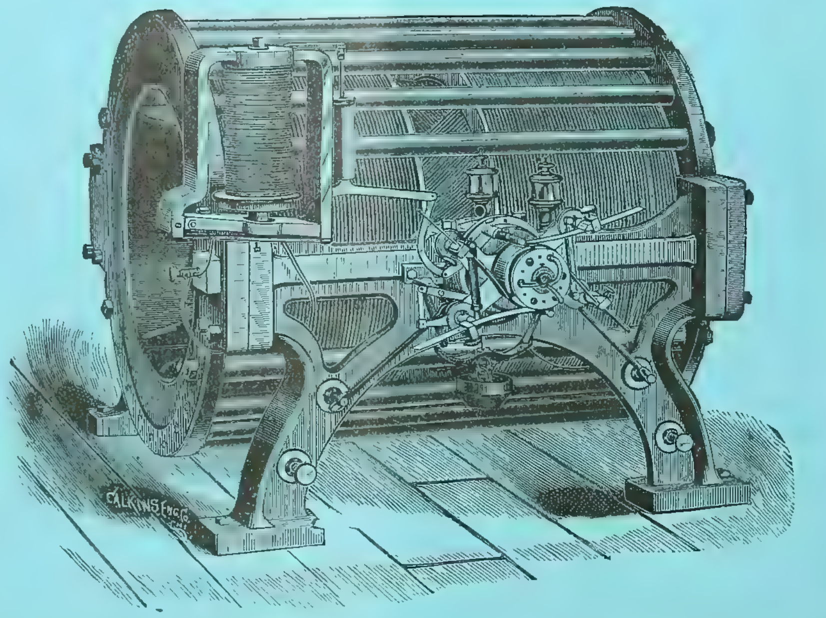

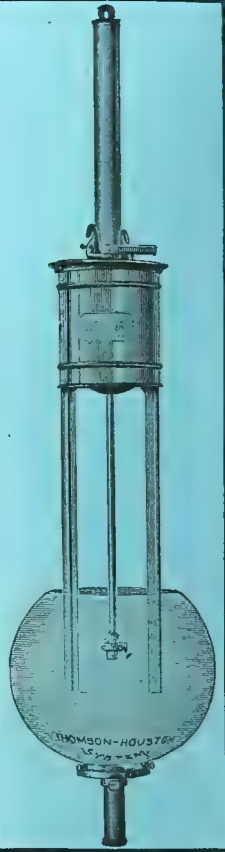

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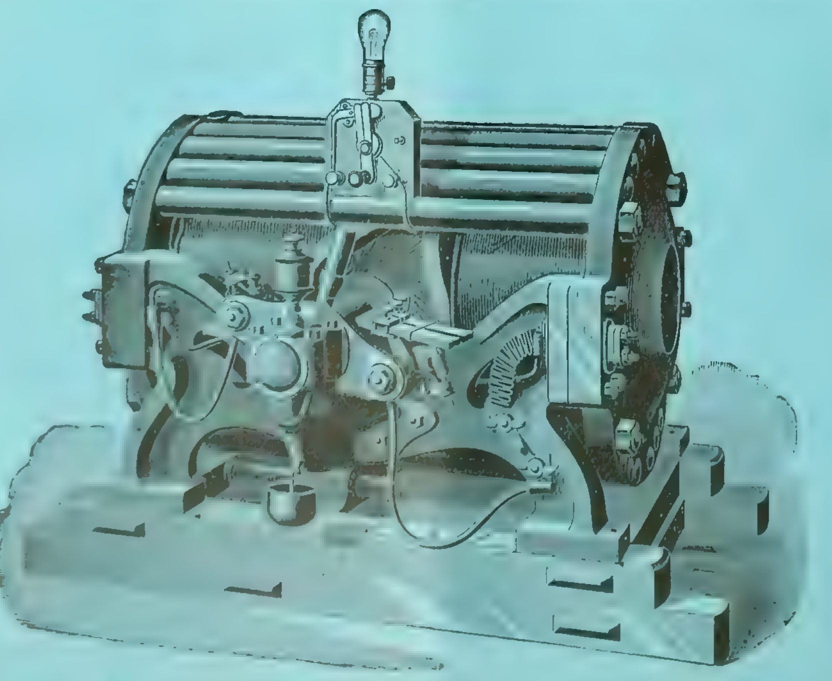

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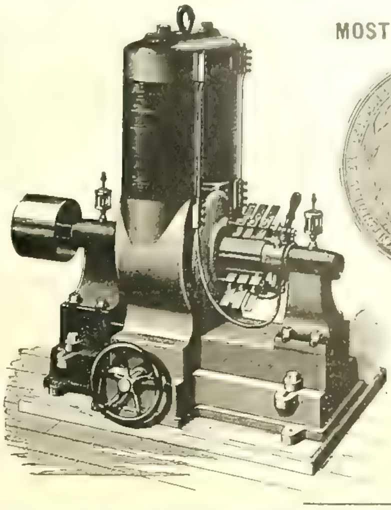

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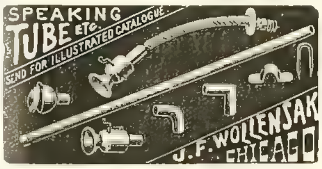

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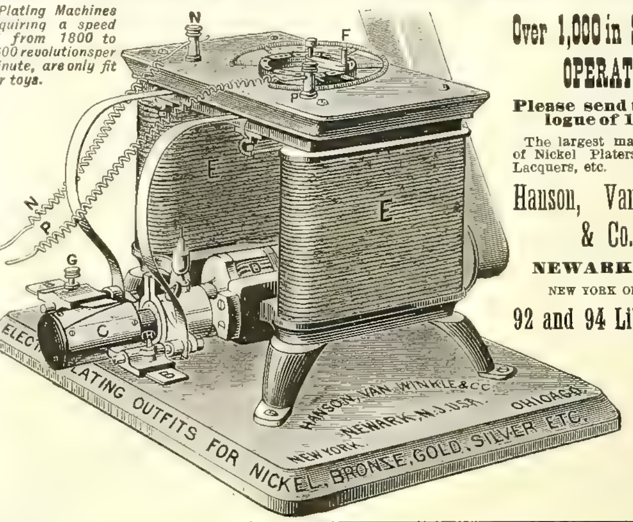

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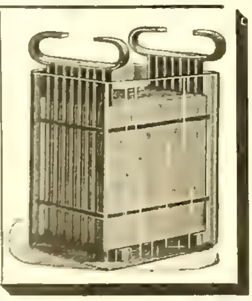

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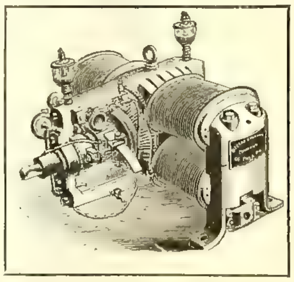

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FOR ALL CLASSES OF OPEN CIRCUIT WORK.

In the latest form the negative element is a ***Double Cylinder, one within the other,*** having more surface and quantity than any other negative element in the market. Its efficiency and durability surpass all its rivals, and ***it is guaranteed for ten years.*** As now made both elements are secured wholly beneath the cover, instead of passing through the cover, as heretofore. The cover is of blue glass and locks tight to the jar, absolutely preventing evaporation of water and creeping of salts. Both binding posts are permanently attached to cover, and thoroughly protected against corrosion.

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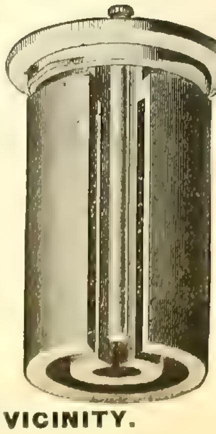
Do not be so foolish as to buy a Prism, Porous Cup, or other perishable negative element battery, when one can be had which is ***PRACTICALLY EVERLASTING.*** And do not waste money by experimenting with any of the numerous new and untried batteries which are constantly coming and going, but buy the "Law," which ***has stood the test of eight years.***



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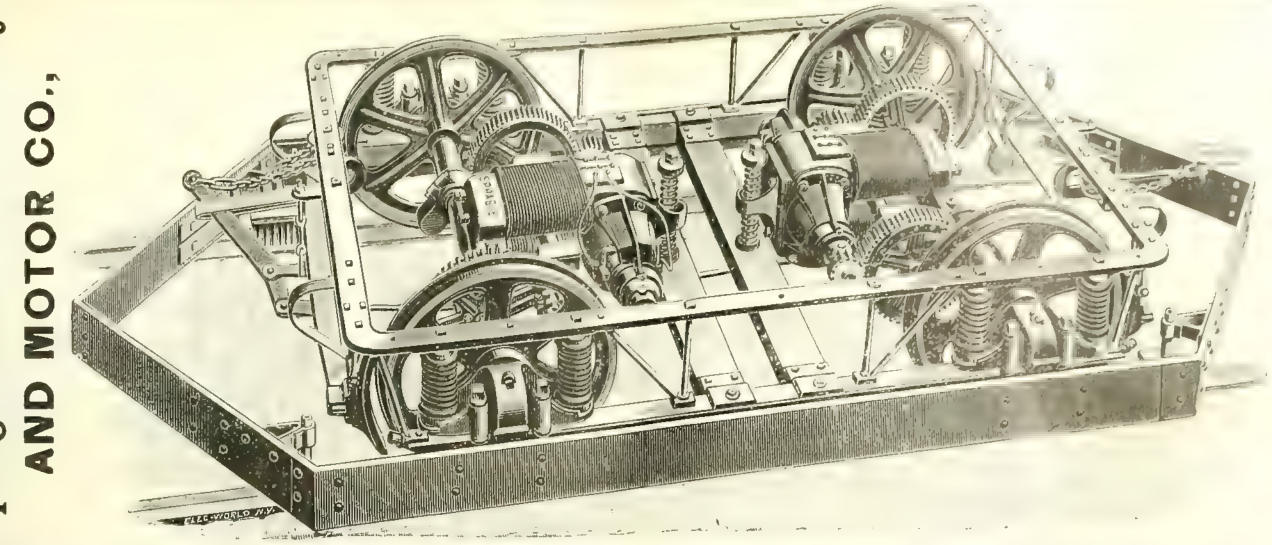

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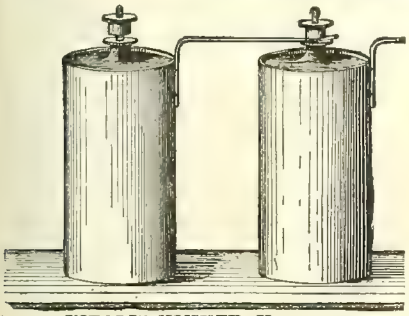

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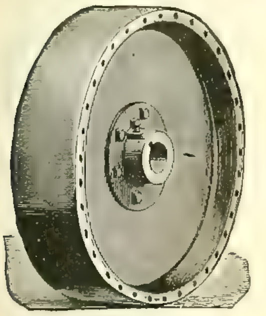

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Is especially adapted for electric plants of all kinds, and has made a record in this field which cannot be excelled.

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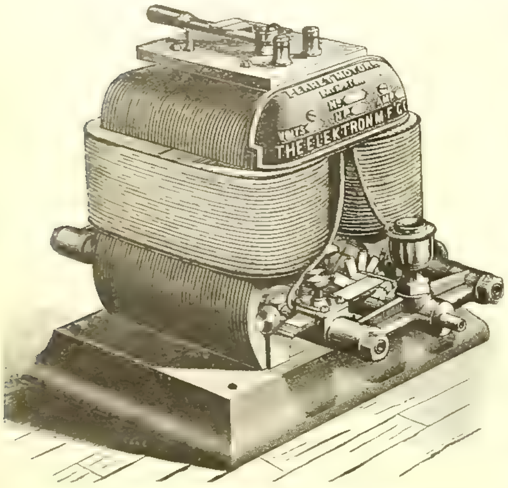

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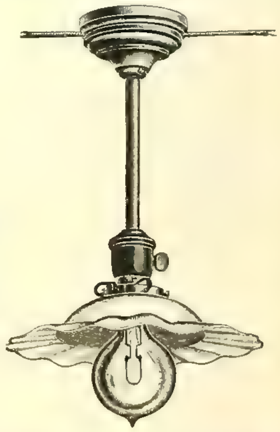

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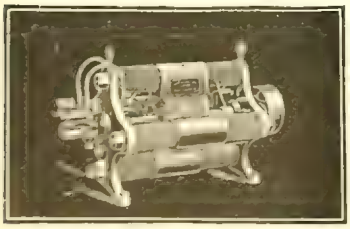

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"**Valve-Oleine**" is a product in the highest state of filtration, is of the greatest viscosity, is entirely free from all acids and absolutely non-corrosive, and without doubt the finest and most thoroughly reliable Cylinder Lubricant now on the market and will naturally lubricate 200 to 300 PER CENT. more than products of lower test. ☞ Is not only the **best** but the most **economical** lubricant.

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Samples of one to ten barrels shipped on request. Correspondence invited. Resident agents wanted.

EDISON TRIUMPHANT!

His Patents Sustained by the United States Supreme Court.

THE EDISON ELECTRIC LIGHT CO.

Takes pleasure in announcing to its patrons and the general public that the decision of the Supreme Court of the United States, filed on the 21st ult., in the case of the Bate Refrigerator Company, is in fact a decision

SUSTAINING THE EDISON PATENTS

In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor ?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

Thus the QUESTION OF LAW having now been settled by the Supreme Court of the United States, and the QUESTION OF FACT by the highest experts of the world, this company now notifies the Public of its intention to call a halt and demand a reckoning for the trespass and abuse of its rights in

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EDISON ELECTRIC LIGHT CO.,

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SUPPLIES FOR ELECTRIC WORK.

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BADT TESTING SET.

The illustration shows this new testing set, designed specially for

LINE MEN,

DYNAMO TENDERS

AND

BELL HANGERS.

It Consists of a Highly Polished Cherry Box,

containing a small dry

GALVANIC CELL,

DETECTOR GALVANOMETER

Of 500 Ohms' Resistance,

CONTACT KEY AND TWO BINDING POSTS.

Tae external dimensions of the box are 5 3-4x3 3-4x2 7-8.

Total weight, one pound and fifteen ounces.

The Galvanometer, Key and Binding Posts are mounted on a sliding Shelf, beneath which is the dry cell. By opening the end of the box, the shelf can be drawn out for inspection or repairs. The standard resistance of the coil is 500 ohms, but we will make them of any resistance to order. One ceil will deflect the needle a few degrees, even through a resistance of 15,000 ohms.

PRICE FOR THE SET COMPLETE, $15.00.

KERITE WIRE.

We are sole agents for the sale of Kerite Wire for the Western States. This wire has been tested by years of actual service and stands at the head of goods of like character.

WESTERN ELECTRIC CO., - CHICACO.

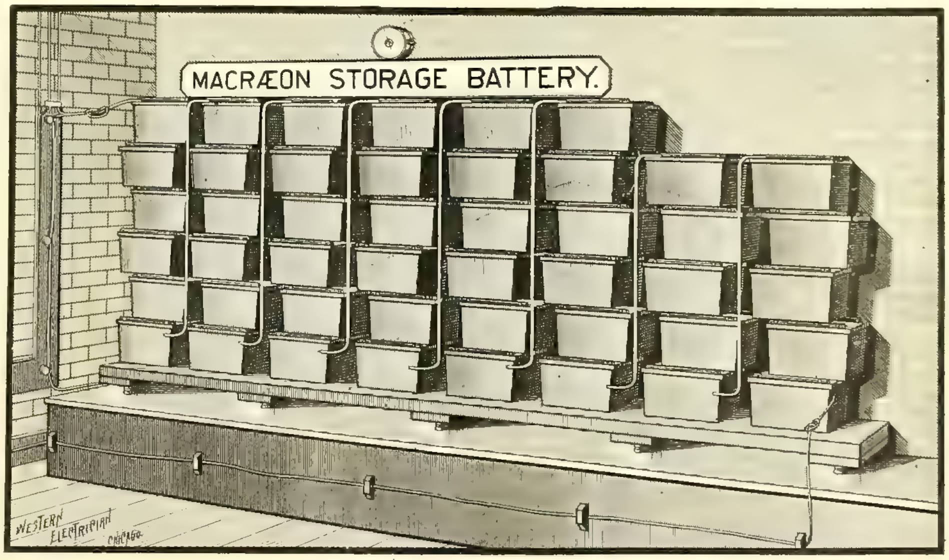
Western Electrician.

EVERY SATURDAY.

Vol. IV. CHICAGO, APRIL 13, 1889. No. 15

The Macræon Storage Battery.

The field for storage batteries is continually widening, and there is a growing demand for accumulators which are thoroughly efficient. An installation of one of the latest improved types is shown in the accompanying illustration, which shows 46 cells of Macræon battery. In this accumulator the plates are attached to the lid of the box, which is constructed of metal. By raising the lid the plates can be separated for inspection or repair. The plates are fixed into the body of the box, and bracing the sides make it extremely rigid, and as it is of metal, it does not warp. The lid prevents "spraying." Lateral bending, or "buckling," is prevented by dividing up the plates, especially the positive plates, into strips so as to give to each strip insufficient strength to bend laterally, and at the same time, by making each strip free and independent of the others, allowing it to expand in the direction of its length as much as it may. It is said that by reducing the bending force in one direction and allowing it full play in the other direction, buckling may be entirely prevented. The negative plates consist of frames of novel construction, into which is cast a fused salt of lead. The positive plates, which are constructed of chemically pure lead, are rapidly "formed" by special treatment, involving electrolytic action in a bath containing nitrite of ethyl.



MACRÆON STORAGE BATTERY

Unlike the usual forms of storage battery in which porosity is obtained by means of pasting with litharge mixed with sulphuric acid and water, in the Macræon battery the active portion of the plates is obtained by fusion, whereby each particle is placed in intimate contact with its fellow, as well as with the conducting or otherwise inactive portion of the plate. Scaling is thus avoided, as well as the separation or disintegration of the plates, because as every portion of the plate is fused to the next, an absolute separation, it is claimed, cannot occur.

The illustration shows the method of connecting up cells, which consists merely in putting one cell on top of another. As the cut indicates, the cells are not arranged in a straight line, but are so placed that an opening in the lid is exposed, through which a hydrometer may be introduced, or water added.

Chicago Electric Club.

The Chicago Electric club held a special meeting April 5th to take action on the question of securing new quarters. President Barton was in the chair. In calling the meeting to order he stated that the object of the meeting was of the most important character, and the future of the club would depend on the result of the members' deliberations. Diagrams of rooms in the High block on Adams street were shown. After informal discussion it was decided to lease two floors in the building for the club. The following committee was appointed to lease and decorate the new quarters: Messrs. Kreidler, Sunny, Pierson, Zimmerman, Terry, Kempt, Guest, Badt, Perry, Leondardt, Wunder, Leonard, Wilmerding, Degenhardt, Baggot and Shay. After the appointment of the committee President Barton spoke in a prophetic vein. He predicted that the change would bring the club to the front at once. It only needed quarters of a suitable character to make it a strong organization in every way. As rooms in every way adapted to its needs were now assured, the club could look forward to the future hopefully. Several members stated that they knew of a number of gentlemen who would join the club at once now that the question of rooms was settled. It was decided to revise the constitution, and Messrs. Badt, Zimmerman and Sunny were appointed to perform the work.

The election of officers will take place April 18th. Messrs. Terry, De Land and Cutter were appointed a nominating committee. They will have a ticket prepared on the 16th.

At the close of the meeting the members of the committee on new quarters met and divided up the work. They have already entered upon their duties, with great earnestness and enthusiasm.

Manhole Explosions.

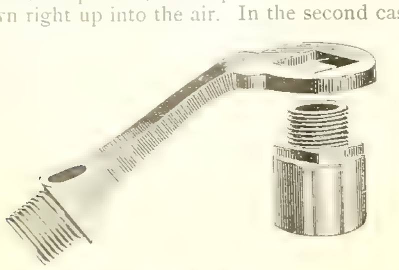
An air of mystery surrounds the subway explosions which occurred in New York city recently. The fact that the conduits were filled with gases is admitted, but the origin of the spark cannot be determined. There were no electric currents passing through the conduits; in fact, it is now known that there were no electric wires in the subways in which the explosions occurred. Numerous theories have been advanced to explain the occurrence, but none of these are satisfactory. A representative of the Western Electrician called upon City Electrician Barrett, of Chicago, to learn his views of the cause of the trouble. He said the main cause was a fault in the construction of the subways, but this could readily be overcome. "You see," he explained, "they did not take [illegible] essary precautions against the admissi[illegible] in their conduits. In all the recently constructed subways in Chicago, we have covered the outer as well as inner walls with cement, and taken every possible precaution against [illegible] of gas. A person who has no experience in these matters cannot imagine how important this is. If you were to drive a bar into the middle of the roadway and pull it up, you would soon get an idea of the amount of gas that escapes from the mains into sewers, conduits, etc. Now, we had an experience in Chicago some time ago that impressed these facts on our minds. A plumber working near an opening of one of these conduits thought he would take a look into it. He accordingly raised his torch to the aperture through which he was peering, and almost instantaneously the manholes along the conduit were blown out. It is quite probable that the explosion in New York was caused in some such manner. As long as the gas mains are defective, there will be more or less gas in the conduits or sewers. But there is no danger if you take the proper precaution. These conduits can be ventilated. Why, there was a time when we couldn't stand the gas that came in this building through the conduit which led the wires into this office. I soon found a remedy, though. I devised a plan for ventilating the conduits, and it is now in the patent office. If you want to see the practical application you can do so by stepping down stairs, and any man in the building will tell you what a change it has effected."

The ventilating device is a simple arrangement, and is certainly effective.

Returning to the subject of the recent explosion, Prof. Barrett said he had learned while in New York that during the last year excavations were made in the streets for public improvements of some kind, and when the workmen reached the depth where they expected to find the gas mains they were surprised to discover no trace of an iron pipe. Further investigation showed that the company had been forcing its gas through an irregular channel where a pipe had formerly been laid. "Many of those old eastern companies have had their pipes down twenty-five years, and to-day they don't know whether or not their pipes are still there," continued Prof. Barrett. "I am informed on good authority that one-third of the gas produced goes to waste in this manner. Under these circumstances, you can readily see how much care should be exercised in constructing these underground subways, and also the necessity for establishing an efficient system of ventilation."

The Chicago Edison company has sixteen miles of underground mains. Little trouble has been experienced with their operation. In two

[illegible] rred in the manholes, [illegible] and no damage was [illegible] d by them. The last explosion occurred [illegible] six months ago. In referring to these, a [illegible] nected with the company said: [illegible] tory theory to [illegible] unt for the explosions. We have came to the conclusion that they are due to the collec- [illegible] nholes. It is a well- [illegible] 15 per cent. [illegible] from the mains, [illegible] ght that the cause for the [illegible] might be found in this leakage, were [illegible] nating gas has [illegible] nholes. It does [illegible] great deal of that kind of gas to be [illegible] on account of the odor. We have therefore settled down to the conviction that the explosive gas is a mix- [illegible] which forms an extremely explosive compound. In the case of the first explosion, the top of the covers were blown right up into the air. In the second case,



[illegible] ATTACHMENT FOR GAS FIXTURES.

the bottom of the box was blown out. In each of these cases there was a short circuit. This was also true in the case of the Boston explosion. It is hard to account for the explosion in New York city, as no current was passing at the time. In order to prevent explosions hereafter, it has been suggested that we put a two-ounce bottle of chloroform—with the cork left out, of course —in each manhole. This plan will be tried here."

A representative of the Chicago Arc Light & Power company said that the circumstances attending the explosion in New York were peculiarly singular. In the first place there were no wires in the conduits, and there was no occasion for any one tampering with them. In fact, they were sealed up, and he did not believe the fire was communicated from the outside. He was not prepared to give an explanation of the cause of the explosion, but he favored the theory of [illegible]. "After some of the explosions that have occurred in our conduits," he said, "we have found no trace of illuminating [illegible], an examination of our wires has failed to reveal trouble in the lines. There have been neither crosses nor grounds. The insulation [illegible] een high, the installation measured up [illegible] the explosions. There [illegible] ent. It was generally [illegible] was spontaneous [illegible]

[illegible] gas business [illegible] the present [illegible] alongside of [illegible] should be on one [illegible] and the electric [illegible] the gas pipes [illegible] nduits, and naturally [illegible] into the [illegible] side of the [illegible] great [illegible] prevent [illegible] onduit; it would [illegible] ry to lay the [illegible] time [illegible]

by a man carrying a lighted torch into the conduit, although when they opened the manhole the volume of gas that was [illegible] rated was so great they could scarcely stand it. Yet they did not give the gas time to escape, but carelessly walked into the conduit, carrying the light with them. The electric light companies, in fact, none of the electric companies notify us of their intention to construct conduits. They tear up the streets and break our pipes in some cases, but never say anything to us about it. The present system of constructing conduits without regard to the location of gas pipes, is the principal cause of all this trouble."

Attachment for Gas Fixtures.

A new attachment for placing incandescent electric lamps on gas fixtures was patented on the 2d inst. by E. F. Gennert, which has several points of merit. An objection to many attachments or arms consists in the fact that when they are placed on the gas fixture nozzle or nipple, and the plate of a gas globe holder is put on top of the attachment, only a few threads are left for the gas burner, which acts as a nut or a lock to hold the globe holders and attachments in position. In turning the key of the electric lamp the attachment is often loosened and the gas burner is partly unscrewed, causing gas to leak. The attachment illustrated herewith successfully overcomes these difficulties. It consists of two parts—a base which is firmly secured to the fixture, and an arm for supporting the electric lamp; the base is supplied with a male thread for the gas burner; under this there [illegible] shoulder, and the eye of the arm be- [illegible] with a corresponding opening, it [illegible] the base. It will be seen that the [illegible] direction correspond- [illegible] on the neck of the base [illegible] be placed below [illegible] arm, and when the gas burner is screwed on, the whole will be securely held.

[illegible] improved upon by [illegible], and using in the [illegible] er of the base a steel pin, which enters [illegible] star-shaped eye.

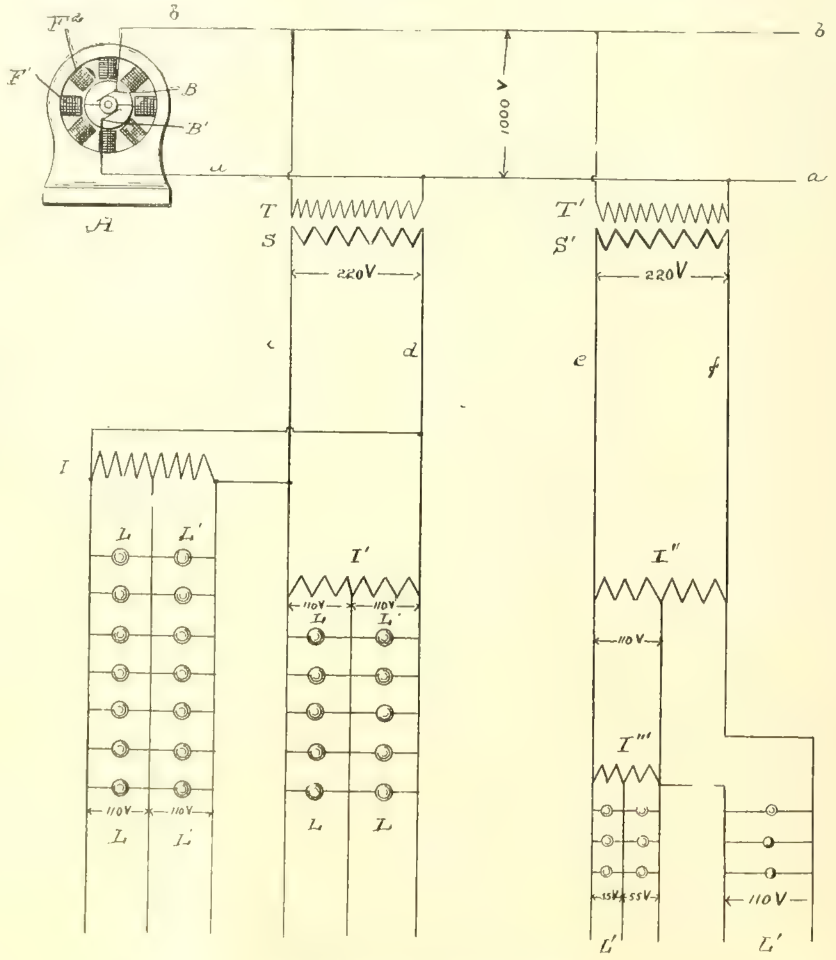
The E. P. Gleason Manufacturing company of New York are manufacturers of the attachment.

Transfer System of Electric Distribution.

The accompanying illustration shows the essential features of a system of distribution recently patented by Edwin H. Rice, jr., of Lynn, Mass. In the cut *A* represents an alternating current dynamo, of which F' F^2, etc., are the field poles, excited, it may be, from any external source, or by a separate winding on its own armature, B B' the brushes bearing on the collector rings, and a b the mains, leading to the translating devices situated on the external circuit. T T' are converters, and the secondary lines are c d and e f.

Connected in multiple across the mains c d and e f, etc., are a number of induction transfer coils, I I' I^2, etc., with lamps L L'. The coils I I' I^2, etc., are not transformers in the usual sense of the term, but are properly equalizers for potential difference existing on different lamp circuits leading from and supplied by current by the coils I I', etc. Thus, should lamps be extinguished in the circuit L, the full number running in the circuit L', both being supplied with current from the same coil, a less number of lamps will tend to run at an increased brilliancy; but the action of the coil I now asserts itself to equalize the difference of potential in the different branches fed by the coil.

It is claimed that this system secures greater flexibility of distribution with greater economy than is at present obtained by the use of either transformers or induction transfer coils alone. In the figure a current with a potential of 1,000 volts is converted into a current having a potential of 220 volts on the secondary mains c d e f. This current is in turn fed to induction transfer coils I I' I'', etc., from which coils, lamps or other electric apparatus suitable for use with alternating currents may be supplied with currents of any desired potential as great as or lower than 220 volts without further conversion. Suitable fuses for safety in cases of short circuits, etc., should be placed in the mains leading to and from the transformers T T', and



TRANSFER SYSTEM OF DISTRIBUTION.

in the circuits leading to and from the induction transfer coils *I I'*.

It will be understood from the foregoing that the subdivision of potential may be carried even to a further extent than is indicated in the drawing, it being only necessary to extend the principle of supplying transfer coils from fractions of preceding transfer coils in the trains of subdivision of potential, and from the final coil to supply the translating devices.

Right and Left-Hand Dynamos.

By F. B. Badt.

Almost weekly I receive letters in which I am asked whether dynamos can be run in a direction opposite to that in which they run ordinarily, and, if so, what changes, if any, are necessary in the machine. It may be of interest to answer these inquiries in this place.

The armature of any dynamo may be rotated in either direction. If the rotation is in the

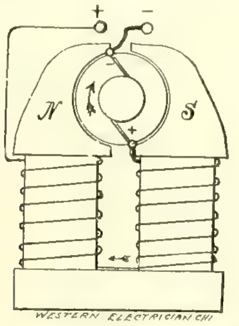


FIG. 1. RIGHT HAND SERIES DYNAMO.

same direction as that of the hand on the dial of a clock, when in front of the commutator and facing the dynamo, it is called a right-hand machine; when the rotation is in an opposite direction the dynamo is called a left-hand machine. As it may sometimes become necessary to "reverse" the direction of rotation of the armature because of the arrangement of the power and the location of the dynamo, the following directions will be of value to the engineer or dynamo tender.

The reversing of the direction of rotation necessitates the following changes:

1. The brush-holders and brushes must be reversed so that the armature will run "with" and not "against" the brushes.

2. The rocker or quadrant must be adjusted so that the brushes get the necessary "lead" in the new direction of rotation.

3. The connections must be changed according to the accompanying diagrams.

These connections are so arranged that the

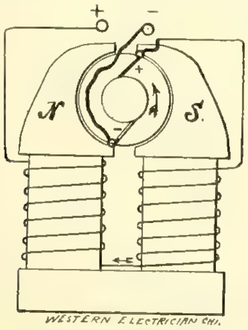


FIG. 2. LEFT HAND SERIES DYNAMO.

main binding posts of the dynamo do not change their sign (+ or —), and the pole pieces do not change their polarity (N or S).

For compound dynamos no diagram is given, as simply the connections for both the series and shunt winding must be changed according to the diagrams.

St. Joseph, Mo., Electric Light Plant,

The city council of St. Joseph, Mo., has awarded the contract for the city electric light plant to the Excelsior Electric company. The bid was $50,753. The Excelsior company will install the plant complete, with the exception of the central station, which will be built by a local contractor.

New York Board of Electrical Control.

In consequence of the recent explosions in the subways, Mayor Grant invited the representatives of the different gas companies to meet the Board of Electrical Control at his office April 1st, for the purpose of investigating the matter and formulating plans for preventing accidents of the kind. A goodly array of gas men responded to the mayor's invitation, among whom were John P. Kennedy of the Mutual Gas company, E. J. Eufer and E. Lalor of the Equitable Gas company, W. H. Bradley of the Consolidated Gas company, and Gen. Spinola of the Standard Gas company. After the mayor had stated the object of the meeting, Edward Lauterbach, president of the Consolidated Telegraph & Electrical Subway company, said that no work of a public character involving the use of the streets of the city of New York, had ever been done with greater care or a greater desire to have every available scientific test brought to bear on it, or had been subjected to a more thorough supervision, than the construction of the conduits and subways of the city. Among the many difficulties that had been met with he alluded to the heat engendered by the Steam Heating company's pipes, which was in many instances over 200 degrees. As to the escape of gas, he believed it was practically impossible to avoid it, at all events unless the efficiency of the present attempts at prevention were materially increased. He did not believe that the explosions had been caused by an electric spark, for in three or four of the first explosions that had occurred there had been, as in the instance under consideration, no electric current present. In conclusion Mr. Lauterbach said it was not for him to decide what were the relative rights of the Electrical Subway and other corporations; he simply desired to call attention to the fact that they were engaged in a general public duty; that, after all, the use of the streets by the gas companies, although they were private corporations, was for the public good. Up to the present time the operations of the Electrical Subway company had been simply for the benefit of the public, as an option had been provided, by availing itself of which the public could eventually come into possession of all the construction work that had been done by the company.

Mr. Lauterbach then read a letter addressed to him by Leonard F. Beckwith, the engineer of the Subway Construction company, which entered at length into the subject of the explosions. There was, the letter stated, an escape of 20 per cent. of gas from the companies' pipes, which were in many instances both badly laid and rotten. The pipes of the Standard company, however, offered a notable exception, as they were carefully laid, and of the very best material. The popular theory that a spark or flame was necessary to an explosion was an erroneous one, 4 per cent. of gas and common air making a mixture that was liable to spontaneous combustion. The system of blowing out the subways which had been adopted had been found to be of great benefit. The sub-soil of the streets was thoroughly saturated with gas which had leaked from the mains, and this and the moist heat from the steam pipes were among the causes of the deterioration of the gas pipes. It was more than probable that to account for the explosion at Fifth avenue, it would not have to fall back on the theory of spontaneous combustion, for a specific explanation was at hand. There had for a long time been a leakage of gas into the basement of the Fifth avenue hotel, and the day before the explosion the smell of gas was unusually strong, and was then specially remarked. The following day a man with a glue pot was preparing to work in the basement. He lighted a fire under the pot, and the flame without being noticed by him, had probably ignited the gas in the air, traveled through the duct which ran into the basement from the subway, and caused the explosion. The cause of the excessive amount of escaped gas was that a cap had been left off one of the mains by the employes of the Standard Gas company.

John P. Kennedy of the Mutual Gas company said that in Mr. Beckwith's letter and Mr. Lauterbach's remarks, it was stated that the gas pipes of the companies were laid carelessly, that they were inferior in quality, and [illegible] the statement that the gas [illegible] ments of the [illegible] The gas had [illegible] was always [illegible] He thought the gas

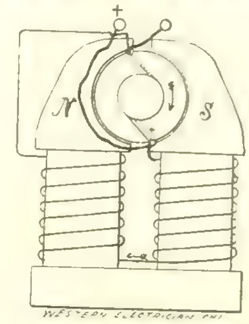


FIG. 3. RIGHT HAND SHUNT DYNAMO.

could be kept out of the subways if they were coated with asphalt cement, but he was sure that it would do no good to coat the gas mains with cement to keep the gas in them. In his opinion, a much better way than using blowers was to ventilate by means of two pipes at different levels. Mr. Beckwith though that this suggestion had no practical value.

E. J. Eufer, of the Equitable Gas company, stated that before the mains were disturbed by the construction of the subways, there had been but little leakage, and if the leakage of the gas pipes was now more than 5 per cent. it was because the subway people had not properly replaced the earth around them.

The discussion was then adjourned to the following day at 1 o'clock, when the investigation was resumed.

Commissioner Gibbens stated that he had read in one of the daily papers a statement of the secretary of the Edison Electric Light company that the Edison company had had no

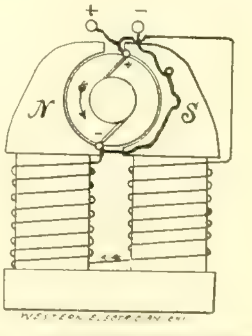


FIG. 4. LEFT HAND SHUNT DYNAMO.

trouble caused by leakage of gas, and that there had not been explosions in any of their conduits or manholes. He therefore called on Mr. Wheeler, who had formerly been in the employ of the Edison Electric Light company, to state what his experience was. Mr. Wheeler stated that there had been a number of explosions in the manholes of the Edison company, and that he knew of a case where the cover of a manhole was blown high enough to come [illegible] top of a house. With reference to the question brought before the board, the [illegible] the leaking gas making its way into [illegible], Mr. Wheeler, in reply to a question of Commissioner Gibbens, said he was of the opinion that gas naturally traveled in the direction of the least resistance.

C. C. Jackson, of the Westinghouse [illegible]

[illegible] siderable experience with natural gas in connection with the [illegible] gh, gave some [illegible] said that com [illegible] pes, the use of which had been discontinued in favor of [illegible] auxiliary joints [illegible] stem of ventilat- [illegible] escape pipe from [illegible] surface of the [illegible] off, and since [illegible] sions. He was of the opinion that not only explosions, but also the appreciable escape of gas, could be pre- [illegible] was a leak of one half of one per cent. they thought it a great deal.

Mr. Andrews, president of the New York Steam Heating company and the Standard Gas company, spoke strongly in favor of ventilation by means of holes in the covers of the manholes, but Mr. Beckwith opposed this on the ground of danger of ignition by matches or [illegible]

Mr. Bayles, commissioner of health, stated, on being questioned by Commissioner Gibbens, that the saturation of the soil by illuminating gas was not injurious to public health. It had [illegible] septic qualities which had the effect of destroying the germs of some diseases.

Further evidence was given by D. H. Bradley, the engineer of the Consolidated Gas company; by Mr. Flannery, of the Standard Gas company, and by Engineer Kearney, and a committee was appointed to make further investigations and to submit a report thereof to the board.

Distribution by Storage Batteries.

A system of distribution by storage batteries [illegible] illustrated in the accompanying cut. The invention is that of William W. Griscom, of Haverford College, Pa., and a patent was recently issued. In his description of his system of distribution, the inventor states that it occasionally happens that when the lamps are being supplied by the battery the dynamo is operating to charge the battery. To do this, its electromotive force is raised above the electromotive force of the battery. This excess in electromotive force is noticeable in its effects at the lamps, and is somewhat injurious. Especially is this true as the battery nears full charge.

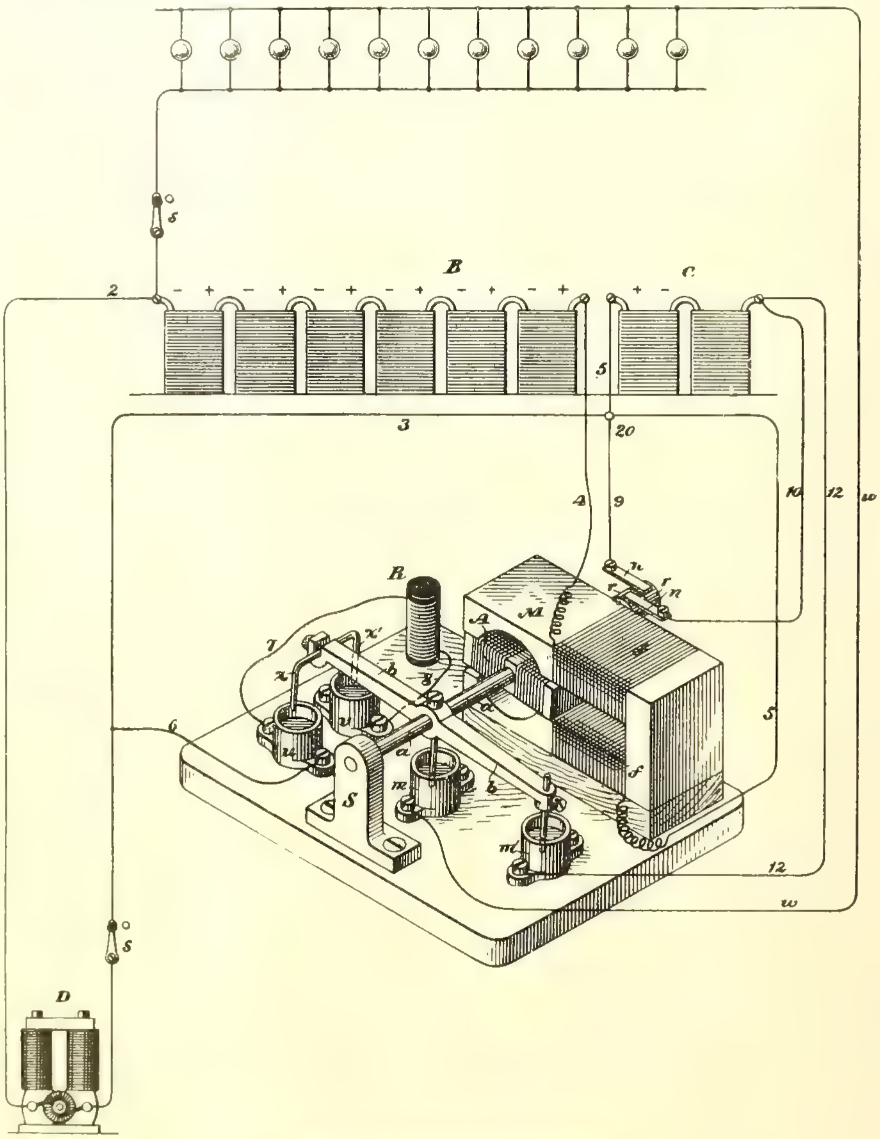
The Griscom system is devised to meet this difficulty; means are provided for automatically inserting and withdrawing a compensating resistance, either wholly or in part artificial. If in part, it is accompanied by a source of counter electromotive force equal in value to the additional artificial resistance required to produce the desired result. This compensating resistance is inserted in the working circuit between the battery and translating devices during the process of charging the battery, and it is withdrawn as soon as the process of discharge is established. Thus the electromotive force at the lamp terminals is maintained constant. For the compensating resistance electrolytic cells are [illegible] reverse, or so as [illegible] to that of the [illegible] at the same time [illegible] maintains [illegible]

[illegible] stance, as de- [illegible] divide [illegible]

counter electromotive force, either or both effective as a compensating resistance.

M is a polarized electro-magnetic device located upon a base board. It consists of iron cores having coils of wire *f*, like the field magnets of a dynamo. The coil *f* has one terminal connected by wire 4 to a terminal of battery, and a similar terminal of the electrolytic cells *C* is connected by wire 5 to the opposite terminal of coil *f*. An electro-magnet, *A*, is placed between the poles of magnet *M*, free to oscillate. Its single coil of wire is connected to insulated rings on the arbor *a*, upon which rest brushes *n n*, which are respectively connected by wires 9 and 10 to opposite terminals of the cells *C*, by which means the magnet *A* is permanently polarized. Upon the board *P* are standards *S*, forming bearings for the arbor *a*. Magnet *A* is fixed to one end of arbor *a*, and arm *b* is fixed

may be traced from the dynamo via conductor 2 to the negative pole of the battery, and from the opposite terminal of the dynamo via conductor 3 to point 20, thence via conductor 5, through coil *f* and conductor 4 to the positive pole of the battery. The battery is in process of receiving its charge. It is assumed that some lamps are in use—conductor *w'* of the working circuit is connected directly to the negative pole of the battery and conductor 2; conductor *w* is connected to mercury cup *m*; circuit passes thence via bar *b*, cup *m'*, conductor 12 to cells *C*, to conductor 5, to point 20, and conductor 3. Current from the dynamo may therefore charge the battery *B* and a portion pass on to energize the lamps. The portion of current from the dynamo which passes the terminal 20 of battery *B* passes through the compensating resistance *C*, which reduces the elec-



DISTRIBUTION BY STORAGE BATTERIES.

to arbor *a* near its opposite end. Near the center of bar *b* a conducting contact dips into mercury cup *m*, which is the terminal of the working circuit *w*. Mercury cup *m'* is electrically connected by wire 12 to the terminal of the electrolytic cells *C*. Upon one end of bar *b* there is a double contact, *x x'*, the contact *x'* being longer than *x*. Both dip into mercury cups *u v*. These mercury cups are connected through an artificial resistance, *R*, by conductors 7 and 8. Mercury cup *u* is connected to conductor 3 by wire 6 at a point between the dynamo and battery.

The apparatus is capable of assuming two positions—first, when current is flowing from the dynamo into the battery, and second, when current is flowing from the battery to supply the lamps.

The apparatus is shown in the first position. The [illegible] consisting of two [illegible] secondary battery, is connected in circuit between the battery and lamps. The circuit

tromotive force by an amount equal to the amount by which the electromotive force of the dynamo exceeds that of the battery.

In the second condition it is assumed the dynamo has stopped producing a current of charge, and that the lamps are being supplied by the battery. No current flows in conductors 2 and 3. Conductor *w'* of the working circuit is connected to the negative pole of battery *B*. From the opposite terminal of battery *B* current flows via 4, *f*, 5, *C*, 12, *m'*, *b*, *m*, to *w*; but as the direction of current through coil *f* is reversed, the position of magnet *A* is reversed and bar *b* is tilted, breaking circuit at *m'* and closing circuit at *u v*. Arm *x'* first enters cup *v*; circuit passing via 4, 5, 20, 3, 6, 7, *R*, 8, *v*, *x'*, *b*, *m*, to *w*. Contact *x* almost immediately enters cup *u*. Circuit then passing via 6, *u*, *x*, to *b*, and cutting out resistance *R*, which is a so-called "spark coil," and is used on the return movement of bar *b* to prevent sparking at the break points *u* and *v*. It will thus be seen that when the dy-

namo is operating to charge the battery, the compensating resistance is in circuit between the battery and lamps; and when the dynamo is idle and the battery is supplying current to the lamps, the resistance is out of circuit.

Harmonic Telegraphy.

Francois Van Rysselberghe's system of harmonic telegraphy has just been patented in this country. The system has many interesting features. The invention is designed to enable a large number of separate and independent telegraphic messages to be sent simultaneously over a single wire, either in the same or in opposite directions.

In the accompanying cuts, Fig. 1 is a diagrammatic representation of an embodiment of the improvements in the transmitter. Figs. 2, 3 and 4 are similar representations of receiving devices.

The inventor states that it has been necessary to maintain a constant relation or proportion between the numbers or rates of vibrations produced and sent by the different transmitters, and these proportions have been those which exist between the musical tones or notes of the musical scale. It followed from this that the operators working the phonic transmitters were never independent of each other. It has also been necessary to have the several receivers tuned and vibrated in exact unison with the corresponding transmitters.

Many attempts have been made to construct and arrange a practical harmonic or tone telegraph system, and to overcome the objections referred to, as well as many other difficulties. In order to overcome these troubles and to produce a practical tone-telegraph, improvements in the apparatus both at the transmitting end and the receiving end of the line, have been designed by Mr. Van Rysselberghe. The improvements in the transmitter end enable the operator to transmit or send to the line a series of vibrations which always bear a constant and invariable relation or proportion to each other, without adjustment by the operators, and which maintain these various rates uniformly, a single rotating axle with several permanently constructed and arranged circuit-controlling wheels is provided, consisting of cog-wheels having

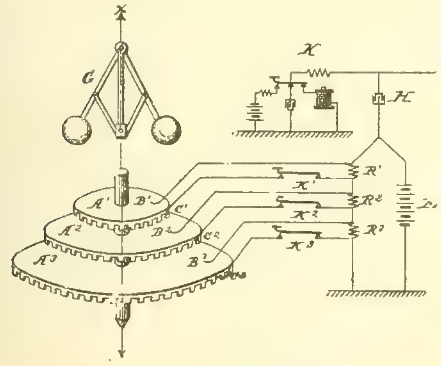


FIG. 1. HARMONIC TELEGRAPHY.

suitable brushes bearing thereon, and each tooth making or breaking contact with one of the brushes as the wheel rotates, the number of makes and breaks produced at each rotation of the various circuit-controlling wheels being prearranged according to the number of electric vibrations, undulations or changes of potential in the line to be produced by the various wheels. The number of changes of electric potential in the line produced by each wheel or other device being thus arranged to bear a position and invariable relation, the rotating axis or the motor is provided to drive the same with a governor that will always maintain the rotation of the circuit-controllers at a constant or invariable rate of speed.

Fig. 1 shows an axis, X Y, which may be driven by any suitable motor. It carries a number of circuit-controllers, A' A^2 A^3, electrically insulated from each other, and brushes B' B^2 B^3 are arranged to permanently contact with the respective wheels, while the brushes C' C^2 C^3 only touch the teeth as they pass successively by the respective brushes. Attached to the rotating axis, or otherwise connected to the motor which [illegible] is an isochronic governor, G, [illegible] controls the axis, maintaining a uniform sp[illegible]. It is represented in the diagram by an ordinary ball-governor for purposes of illustration only, as such a governor does not produce isochr[illegible] movements. The battery or other [illegible] electromotive force, [illegible] is [illegible] branch of the [illegible], in another branch [illegible] is a series of resistances, R' R^2 R^3, each of [illegible] may be short-circuited through the respe[illegible] wheels and brushes by closing the corresponding key, K' K^2 K^3. A condenser, H, is [illegible] being interposed between the battery and the line L, and by this arrangement it will be seen that the tone[illegible] harmonic telegraph may be [illegible] in connection with an ordinary Morse or other usual form of telegraph, K, the currents of which are preferably rendered gradual in their emission and extinction, so as not to affect the phonic receivers. With the arrangement as thus indicated, the axis being rotated at a uniform rate of speed, if one of the keys is closed the corresponding resistance will be shunted each time a tooth of the corresponding wheel comes in contact with the brush, and each shunting

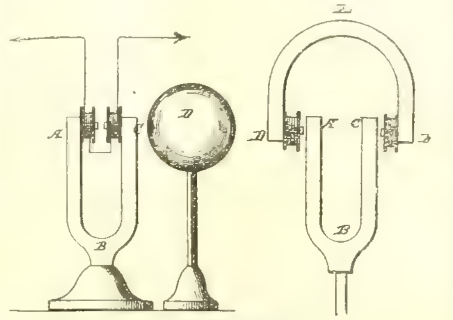


FIG. 2. HARMONIC TELEGRAPHY. FIG. 3.

will create a corresponding change in the electric potential upon the line through the inductorium or condenser, if such be used. If the three keys closed together and the wheel A' provided with thirty-two teeth or contact-pieces, the wheel A^2 with forty-eight pieces, and the wheel A^3 with seventy-two pieces, in the proportion of 4 6 9, and if the wheels rotate four times a second, it will be evident that the closing of the key K' will create 128 electric variations in the line wire, the closing of key K^2 will create 192, and key K^3 288 vibrations per second. It will be seen that the numbers of these electric vibrations will always bear the same relations to each other—namely, the proportions of 4 6 9—and it happens that they will correspond to the musical tones of do' sol' re², and these three tones will exist simultaneously and electrically upon the line wire, and, their relations being uniformly maintained, they will not interfere with each other in the least.

It is evident that the same number and uniform rate of vibrations may be produced by increasing the number of contacts in the wheel and decreasing the rate of rotation, or vice versa, as it always happens that no matter what the rate of rotation of the axis may be, the variations in the current produced by the circuit controllers always maintain the same relation to each other. The same principle apparently may be carried out with a greater number of circuit controllers moving in exact synchronism. In order to receive these tones separately and without interference from each other, use is made of a receiving apparatus.

In Figs. 2, 3 and 4, A B C represent a magnetized tuning fork, the fundamental note or tone of which corresponds to one of the circuit controllers of the phonic transmitter. In the form shown in Figs. 2 and 4 the tuning fork itself is a magnet, the legs forming the poles thereof, and each b anch is provided with an electro-magnet, the coils of which are included in the line wire. In the form shown in Fig. 3 the fork itself is not necessarily magnetized; but the magnet D E E, having a coil connected to the line wire on each of its ends, is arranged in proximity to the tuning fork, so that the legs thereof act as armatures to the magnet. Any electric tone or set of electric variations coming over the line will cause the fork to vibrate, even when such tone is not in unison with the fundamental tone of the fork. In other words, the fork may be said to act to a [illegible] heard [illegible] vibrat[illegible] raphy [illegible] tinctly [illegible] but the desired tone in [illegible] Resonator [illegible] distinction between such a resonator a[illegible] dinary sounding-board or oth[illegible] such as [illegible] not only to the fundamental tone, but to the harmonics thereof, and while such sounding b[illegible] or boxes increase every sound, the spherical resonator res[illegible] mental note and tends to suppress all other tones. The resonator consists of a hollow ball with one or more holes in it, and the single note to which it will respond depends upon the diameter of the ball and the holes. When such a resonator is arranged in conjunction with the improved fork above described, the fork and resonator respond loudly each time the fundamental note or tone is sent through the wire and are silent to all other sounds. The resonator should be mounted upon a base separate from the tuning fork.

In Fig. 4 is shown one of the openings of the resonator covered with a diaphragm, M N, and a pendulum, P, bears upon the diaphragm, shunting in short circuit the coil or relay S, in circuit with the local battery E, and when the diaphragm is vibrated by the fork the pendulum is

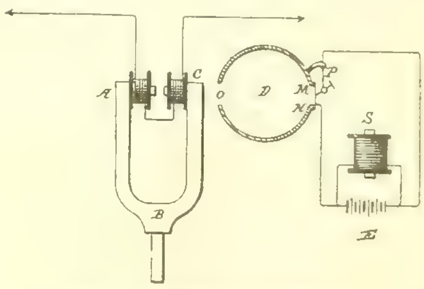


FIG. 4. HARMONIC TELEGRAPHY.

moved, making bad contact with the diaphragm, and the battery puts the relay into operation.

Underground Wires in Boston.

During the recent convention of the National Electric Light association, a party of Bostonians visited Chicago ostensibly for the purpose of securing information bearing on the question of underground wires. Upon the return of the party to Boston, it is reported, a wet blanket was thrown on the movement in that city [illegible] electric wires. The matter, however, was not permitted to drop. The Citizens' association took up the subject, and prosecuted [illegible] with vigor. It is said that these investigations have led to many interesting discoveries, and it is charged that the committee either [illegible] ignorantly distorted facts and [illegible] the entire matter. The secretary of the Citizens' association [illegible] with Prof. Barrett, city electrician of Chi[illegible] and he [illegible] [illegible]

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AN interesting account of the proceedings in [illegible] brought by the Western Union Telegraph company against the Board of [illegible]trical Control, will be found in the regular New York letter.

[illegible] storage batteries is a prob[illegible] attracting considerable [illegible] worked out by William W. Griscom is described and illustrated else[illegible]

[illegible]

[illegible]

[illegible] Mr. [illegible]

great value to men engaged in telephone work. He has made the subject of telephony thoroughly interesting to a large class of readers. We are confident that they will regret that the series has been brought to a close.

F. B. BADT, in a rather caustic communication, presents in this issue his views on the subject of a primary battery scheme, an account of which appeared in the WESTERN ELECTRICIAN of last week.

THE people of New York have grown tired of the service which the Manhattan company is pleased to call "rapid transit," and there is little likelihood that the franchise of that corporation will be extended. The cable roads do not receive much encouragement, and the outlook for electric railroads in the metropolis is becoming brighter each day.

TWO LETTERS from Detroit, published in this issue, show that the question of burying wires is a vexatious problem in that city. A statement from a representative of the telephone company shows that already considerable progress has been made in putting the wires underground. The question is also bothering the city council and the electric light company at Indianapolis.

PRESIDENT BARTON stated at the last meeting of the Chicago Electric club that the organization only required suitable quarters to make it one of the most prosperous clubs in the country. The remark was made just before the club took decisive action on the subject of securing new rooms. The question has now been settled, and a committee has been appointed to secure new quarters which are in every way adapted to the needs of the organization. It is a matter for general congratulation that the club which during its comparatively short existence has performed so much excellent work, is to be placed on a better footing. An energetic, enthusiastic committee is hard at work, and the result of its action will soon be made known.

CONSIDERABLE interest is taken at the present time in the Eckhardt-Baker telephone bill which is now before the Illinois legislature. It is a measure which has had a disturbing effect whenever it came before the legislators. A rather lively debate took place last week, and the discussion waxed warm. Several members of the house tried to secure the advancement of the bill by suspending the rules. When their efforts failed they insinuated that those who had voted against them were influenced by improper motives. It is stated that a few more incidents of this kind will unquestionably kill the bill. The telephone company has issued a statement, presenting its side of the question. An abstract is given elsewhere. It seems to be a fair presentation of the case.

THE news comes from London that Mr. Ferranti is hard at work on an alternating current motor to be used on the circuits of the Deptford station. It is said that he has discarded several methods of construction, but is now at work on a machine which he thinks will be successful. The report that he has designed a practical motor has created considerable interest in electrical circles in England. The London *Electrical Engineer* doubts the rumor. It adds: "There is no possible doubt but the most important invention required for any purpose whatever in the whole world at the present [illegible] is a good-working, economical alternate current motor. The man who invents such a machine will rank far above Watt, or Gramme, or Edison, and will command a fortune such as [illegible] dreamt of — that is [illegible] half a dozen inventors do not hit [illegible] at the same time."

[illegible] electric lighting [illegible] constant dread. At [illegible] the Ohio Gas Light as[illegible] considerable attention [illegible] electric lighting, and *Progressive Age* notes with pleasure the fact that the gas men are rapidly becoming convinced of the wisdom of its proposition for gas companies to furnish electric lights. The discussion on this point was the leading feature of the convention. Many gas men, however, do not relish the thought of recognizing the electric lighting interest as a formidable competitor, and these deluded victims of their own folly are endeavoring to find some consolation in the fact that they have so long been established that it will be many years before the electric light companies can dislodge them from their position. At a recent meeting of the London, Eng., Gas Light & Coke company this position was assumed by the chairman, who made an address, in which he said: "There is no doubt that the electric light is a very great comfort, and very beneficial to the public, but I say it does not compete with us. Electric lighting is a very fine, healthy child; but it is like other young children, it has troubles to come. A great many of those troubles are looming up in connection with the question of laying wires overhead and underfoot, and they will have their difficulties with the vestries as we have had. I do not know whether the steam rollers will hurt them much, but there are other matters which the vestries will find impede the use of the electric light in the streets of London. I do not think we shall hurt it, amd I am sure it will not hurt us. We have taken eighty years to arrive at our position, and they will have a considerable number of years yet to exist before they will be in such a strong financial position. To compare our business with theirs is like comparing the business of a young man who has just started with that of an old gentleman who has accumulated a large fortune, and has a good going concern." That is an excellent illustration of the relative positions of the two industries. Many of the gas companies are certainly of the old fogy order, while electric lighting has enlisted in its ranks the brightest and most energetic business men of the day.

CONSIDERABLE space is devoted in this week's issue to the presentation of facts and theories in reference to explosions in conduits. The topic is one of great practical importance, as a large number of companies of late have been compelled to face the question of burying wires. The New York Board of Electrical Control wrestled with the subject at its last meeting, a full report of which is presented elsewhere. The representatives of several gas companies were present. They thought that the estimate of 15 per cent. leakage from gas mains was much too high. They also claimed that these mains were as well constructed as possible. It will be noticed it was not questioned that the explosions were the result of the ignition of illuminating gas which leaked from the mains. Another article in this issue presents Chicago experience with explosions in conduits. Prof. Barrett states that he has no trouble at present inasmuch as he has devised a method of ventilating the subways. He thinks that about a third of the gas escapes from defective mains, and he gives a striking illustration of poor construction. He assumed that the escaping gas was the cause of the trouble. A representative of the Edison company, however, says it has been ascertained that the cause of the explosions in the Edison manholes was not illuminating gas, but sewer gas. The explosive compound which collected in the manholes was without exception, odorless. In New York the spark which exploded the dangerous gas has been located by the Subway company. The blame is laid upon a workman, who lighted a fire under a glue pot. It will be noticed that there is a difference of opinion as to the immediate cause of the Chicago explosion. A representative of the Arc, Light & Power company inclines to the theory of spontaneous combustion, while the Edison company inclines to the belief that the spark proceeded from its wires. The subject is one of great interest, and it is to be hoped that the committee which the Board of Electrical Control has appointed to investigate the matter may present facts which will throw light on the subject, and suggest means for the prevention of explosions.

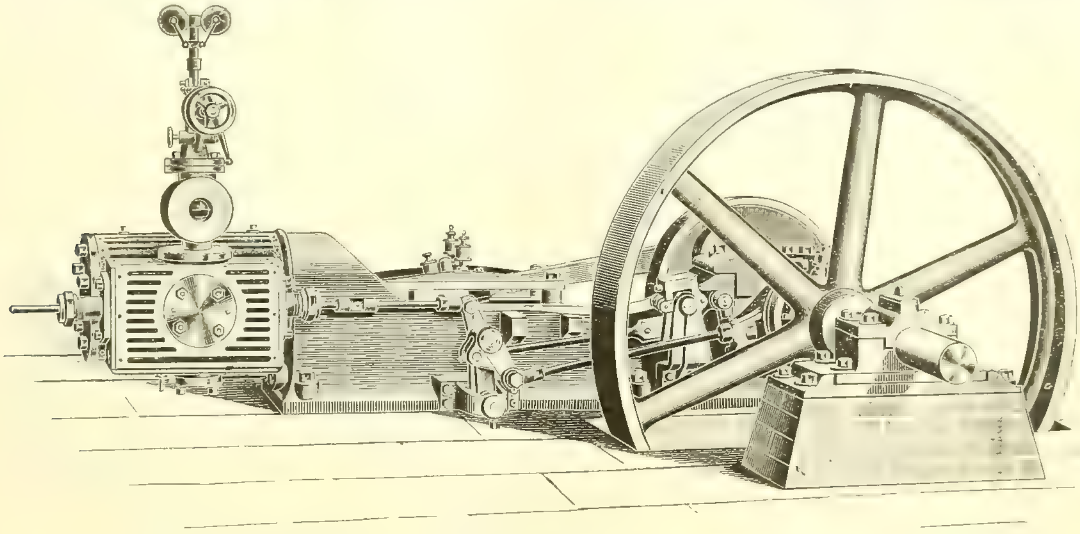
The Meyer Engine.

The accompanying cut illustrates the Meyer fixed cut-off engine, designed for either high or low speed, and for heavy and continuous duty. Its characteristic feature is its valve gear; it moves the valves with such rapidity at the proper moment, that steam is admitted into the cylinder, it is asserted, at absolute boiler pressure.

This result is attained by reason of the fact that the eccentric is always in the center of its travel when the piston is at either end of the stroke, and just when the valve is at the point of opening and closing the ports.

The valve derives its motion from the bell crank lever operated by a single eccentric, cutting off the steam uniformly at half the stroke, and closing the exhaust at eight-tenths of the stroke. In order to secure the greatest benefit from expansion, the steam should not be admitted into the cylinder beyond that point at which the speed of the piston begins to decrease, which is at half stroke. This is accomplished with a very simple and positive valve motion.

The valve is of the piston type, and is made as light as possible and fitted with spring rings, which travel in removable seats, which can be replaced without taking the cylinder from the frame. It is relieved from pressure, and having a constant travel will always keep steam-tight. The bed-plate is an improved form of the Porter type, made more rigid between the main bearing and the slides. The disk crank is properly balanced in accordance with the weight of the reciprocating parts. The connecting rod is made three times the length of the stroke, and the crank pin, cross-head pin and valve connections are made of steel, hardened and ground to a true cylindrical fit. The engine is made by the Davenport, Ia., Foundry & Machine company.



THE MEYER ENGINE.

Mysterious Incorporation.

A dispatch from Springfield, Ill., under date of April 5th, announced the incorporation of the United States Vogel-Kazophone-and-Electrical-Micophone-Trumpet-Acoustic-Electromotor-Power-Musical-Car-Distance-Loud-Speaking-Transfer-Instrument company of Chicago. The incorporators are William Vogel, Adolph Gray and Richard H. Dakin. The capital stock of the company is $60,000,000. Adolph Gray, whose name appears among the incorporators, is a real estate broker, with an office at 79 Clark street, Chicago. A representative of the WESTERN ELECTRICIAN called upon him to learn something of the nature of the new concern, but he positively refused to make any statement further than that the world would soon be astonished by the wonderful concern in which he was interested. The articles of incorporation represent the object of the company to be the manufacture of instruments, the renting of rights and privileges. What these instruments were, or the nature of the rights and privileges which the company desired to dispose of, Mr. Gray refused to disclose. To all interrogations he had but one reply to make: "I have no information to give you." When urged to satisfy public curiosity by throwing a little light on the subject, said: "You will know soon enough. You ought not to ask me to give up my secret."

Practical Telephony.

By THOS. D. LOCKWOOD.

PART XX[illegible]

In large telephone central offices the multiple switch board is now almost universally employed. In this series of papers I can barely indicate the distinctive features of this organism. Its essence is that the call-receiving annunciators are divided between the number of sections, each attended by an operator, the calls being answered each at the section where its annunciator is located. But each section, in addition to the annunciators and answering spring jacks of the lines properly belonging there, is fitted with spring jacks also for all the other lines entering the station.

Thus each subscriber's line coming in passes through a spring jack at each section of switch-board, and finally to the annunciator at that section to which it belongs. Every operator in this way has access to every line. It is, however, obvious that, unless there be some means provided whereby an operator at any one board can tell whether any given line be already in use at another, the ability to connect with any line at any board goes for nothing. Therefore, there must be some means provided for accomplishing this. One way which has been much used is to connect the frames of the several spring jacks of each circuit together by a wire otherwise insulated.

When any line is brought into use by the insertion of a connecting plug, a cross is produced by the metal of the plug between the jack frames, and thereby the insulated wire connecting them and the line. This virtually, in the case of earth return circuits, puts a ground on the entire number of jack frames of the line in question. Now, there is included in the operator's telephone circuit one or two cells of battery. These are, of course, ordinarily on open circuit. If, however, before inserting the plug, the operator touches the frame of the jack with its point, one of two things happens. If the line represented by that jack be already in use at some other switch-board section, there being already thereby a ground on the test line, the circuit of the operators' battery will be closed when the plug end touches the frame, and a click will be heard in the receiving telephone. The occurrence of such a click thus denotes that the line is in use.

If, on the contrary, the line be not in use the touch of the plug end cannot close the battery circuit, and no click is heard. The operator then proceeds to insert the plug and complete the connection. Many alternative plans have been proposed; none, however, for single wire circuits have proved as practical as this. Mechanical and visual signals have also, to some extent, been employed. In Denver a notable instance of a combined mechanical and visual signal is to be found. The plug-socket in the [illegible] a line in [illegible] ing apparatus, and many n[illegible] cuits.

[illegible] matter relating to the central [illegible] series of papers, which this brief [illegible] hausted.

The Pennock Primary Battery Scheme.

Editor W[illegible]

My attention was called [illegible] the Chicago [illegible] March [illegible] nock primary battery [illegible] WESTERN ELECTRICIAN on the [illegible] the office of the company and [illegible] ferring to the merits of the Pennock battery for electric lighting. In looking over this circular I happened to see my name mentioned in the report of an electrical expert who examined the system. I naturally became interested in the subject matter.

Mr. Pennock claims that the report was made by a "well known electrician of Chicago," who was sent by a capitalist to investigate the system of electric lighting by primary batteries as now exhibited at the office of the Pennock Battery, Electric Light & Improvement company. I find that the writer of that report, which is signed [illegible] is a man by the name of Ash, who is employed by the Western Electric company to put up electrical apparatus. He does not claim the title of "electrician," and certainly the characterization "well known" is a misnomer. His "report" was written to a relative, and should never have been published, as it was simply a private letter.

Mr. Pennock seems to rely upon the report of this "well known electrician" of Chicago to a great extent; and takes exception only to the statement "that it is cheaper to burn coal under a boiler than to burn zinc in a battery for the generation of electrical energy." Mr. Pennock [illegible] states that he very much regrets that his [illegible] tests and comparisons of primary batteries, as gene[illegible] of electricity, with the other means of [illegible] light and power, are all in his [illegible]

I would advise Mr. Pennock, [illegible] these data to Chicago as soon as possible [illegible] occasion to use them.

Mr. Pennock seems to think that [illegible] ing the report of the "well known" [illegible] an end to all the contr[illegible] ten by men whose knowledge of [illegible] entirely superficial regarding the consumpti[illegible] compared with the burning of coal [illegible] whatever about the details we have [illegible] electric lamps [illegible] zinc instead of coal." [illegible] answer, and [illegible] I have [illegible] are very good [illegible] but I [illegible] scheme has been shown in New York [illegible] I hope that the [illegible]

[illegible] table firms who [illegible] in the public [illegible] trical work. Every elec[illegible]per, in my opinion, should strive to throw all [illegible]

F. B. Ball.

[illegible], Apr[illegible]

The Callender Company.

[illegible] was received [illegible] "The Callender [illegible] company, of [illegible] Newark, has become [illegible] suspended opera[illegible] [illegible] ted in 1883, [illegible] $ [illegible]. The [illegible] the company to [illegible] May 31, 1888, [illegible] exclusive of the [illegible] $ [illegible] liabil[illegible] [illegible] A meeting of the creditors was held to-day at the Astor house. Those present [illegible] for publication, [illegible] Mr. Callender made a [illegible] definite statement of the company's [illegible] lition, showing unsecured liabilities of about [illegible] and asked for an extension of about six months. A committee of [illegible] to examine the books, [illegible] the company's affairs, and report at a future meeting."

Eckhardt-Baker Telephone Bill

An effort was made in the Illinois house of representatives to rush through the Eckhardt-Baker bill, which reduces telephone rentals throughout the state. Mr. McElligott asked unanimous consent to take up the bill for first reading. He made the following remarks which indicate the pressure brought upon the members to secure the passage of the measure: "There is not a member of this house who has not received dozens of petitions asking for the passage of a law that will regulate telephone charges. For two weeks I—and I think every other Cook county member—have received from twenty-five [illegible] asking for the passage of this bill." The motion failed to receive the requisite two-thirds vote, and the rules were not suspended. As it has been stated that the telephone companies would cease operations if the bill became a law, Senator Eckhardt has introduced a bill which prevents under penalty of [illegible] company from refusing [illegible] erate. The first section of the bill is as [illegible]

[illegible] that any corporation [illegible] of the state of Illi[illegible] operating or controlling a telephone line or [illegible] system within this state shall fail or [illegible] to furnish telephones or telephone service at the rental or charges fixed by law, or shall abandon or refuse [illegible] or telephone exchange [illegible]n at the rental or charge fixed by law, or shall refuse [illegible] state to such [illegible]ration, then the state's attorney of the proper county, [illegible] individual [illegible] to any court of record of [illegible]

[illegible] to kill the [illegible]

[illegible] through [illegible] is about $3.49 per month, but this average rate would fall far short of covering the actual expense of furnishing telephone service in larger cities. [illegible] rates proposed by this bill are but a small reduction to each subscriber, but to the Central Union Telephone company this reduction is a great matter, involving the difference between moderate returns upon an investment and the impossibility of continuing the business at the prices named in this bill. The difference between existing business and residence rates is due to the fact that business subscribers use the telephone more than residence subscribers, and get more benefit from it at an increased cost to the telephone company for furnishing the service. The practical result of the bill would be to give business men, who use the facilities most, who [illegible] greatest [illegible] whose service entails a greater expense upon the telephone company, the same rate as the residence subscriber, who receives but comparatively little service and corresponding benefit. It would, in fact, be taxing the housekeeper for the benefit of the business man, by making the housekeeper pay a portion of the expense of the business man's service.

After pointing out the uncertainty as to the proper basis of rates for telephone service, the company says:

The bill under consideration has peculiar features of injustice, to which attention is invited. There is but one city in Illinois which had a population of 60,000 at the last Federal census. There has been no state census since 1880 Six dollars per month for telephone service named in the bill would apply only to Chicago. We think the bill allows the $4 rate in but two cities in the state, namely Peoria and Quincy; in all other cities in Illinois this bill allows only $3 per month for exchange service. This was the price named by the Indiana law which was passed in 1885, was in force four years, and has just been repealed. The "Eckhardt-Baker" bill, if a law, would reduce the gross receipts of the Central Union Telephone company about 35 per cent., which is much more than the total profit on its last year's business. One of the objectionable features of the "Eckhardt-Baker" bill is that it would fix the same charge for telephone service no matter what the distance from the central office, and the same price for business use as for residence use. To make these proposed changes would throw most exchange subscribers into great discontent. This experiment has been tried and abandoned because not satisfactory or fair. Nearly all telephone lines thus far built were established at the urgent request and with the co-operation of the people who were to use them, and who were glad to get the facilities at the rates to be charged The companies operating in this and adjoining states are engaged in building toll lines from exchanges to outlying towns too small to support telegraph offices. Applications are now held from over 200 additional towns asking for such connections, but restrictions placed upon this branch of the business, as proposed, would render it impossible to extend these facilities, and would necessitate closing most of the outlying stations already established These stations could not be maintained even at present rates were it not that public-spirited citizens of such towns act as agents, at meager rates of compensation, in order to foster the facilities afforded.

On April 6th the bill was ordered to a second reading. As the bill will probably have to wait its turn till the hundred others on the calendar ahead of it are disposed of, it will not be reached for three or four weeks, and it is difficult to predict the fate that awaits it. Mr. Baker says if the bill can be shown to impose unreasonable burdens upon the telephone company in any particular, he is willing to raise the rates. It is not his intention to cripple the company or necessitate its removal of the telephones now in use.

Central Station Lighting.[1]

BY [illegible] FORBES.

It is the universal practice abroad to make the size of the feeders such that the loss of pressure in these feeders is the same in all. This involves the use of very large feeders when their length is great, and great waste of energy when the length of the feeder is small, but it enables all the feeders to be supplied by dynamos at the same pressure, which may therefore work in parallel. This arrangement is simple to work, but it is wasteful. I find that we can save enormously in copper at a slight extra trouble in working the central station. I would prefer [illegible] three groups, feeders [illegible] the same length and having the same [illegible] feeders could be made of the [illegible] according to Sir William Thomson's [illegible] the dynamo working [illegible] higher pressure than those working [illegible] When the load is light all the dynamos [illegible] because the loss in the [illegible] and the dynamos [illegible] might at be upon.

[illegible]

[illegible] the pres[illegible] coming from the point [illegible] pilot wires [illegible] voltmeter at the [illegible] by an attendant [illegible] grouped together [illegible] the pressure at the [illegible] however, the [illegible] the [illegible] very [illegible]

[illegible]

sirable, but I hold that hitherto the pilot wires have generally been placed in the wrong position. Suppose that a 4 per cent variation exists over the district of mains supplied by any one feeder, and that the point where the feeder strikes the mains is kept at constant pressure, then the most distant lamp supplied by that feeder has a variation of 4 per cent. If, however, the pilot wire came from a point half-way between the most distant lamp and the feeder, and this point were kept at constant pressure, the maximum variation of pressure would be reduced to one-half, and would be only 2 per cent. It appears, then, that by properly placing the pilot wires the variations in pressure can be reduced to one half; or, keeping the variations of pressure the same, the quantity of copper in the mains may be reduced to one half.

In these suggestions as to dynamos at different pressures and as to the position of pilot wires I am supporting a course which has not been generally adopted anywhere, but the improvement ought only to be mentioned to receive general recognition.

LAMPS OF DIFFERENT VOLTAGE.

It has often been proposed to supply different parts of a district with lamps of different voltage. In the ordinary plan of using feeders and pilot wires the maximum pressure at the most distant lamp supplied by any feeder is the same as the pressure in the mains at the feeder. The minimum pressure may be, let us say, 4 volts less. Suppose 100-volt lamps are used, those near the feeder will always have 100 volts, but the most distant ones will have pressures varying from 96 to 100 volts. Ninety-six volts would make the lamps very dull; and if at the distant points lamps of 98 volts were used, the pressure would never vary more than 2 per cent. from the normal, and a better light would be obtained. This would be a very good arrangement if we could lay out a district from the beginning with all the positions of the lamps established, but it is found as the station progresses a house which would have required 100 volts yesterday may require a limit of only 99 volts to-day, owing to the introduction of additional lamps between it and the feeder. Experiments which have been made in America on this plan have led to disastrous results and hopeless confusion in completing the scheme. This plan has been completely abandoned, and in the present state of the industry I think that this abandonment has been wise.

I do not think a greater variation of pressure than 2 per cent. up and down should ever be allowed, if you wish to supply a satisfactory light.

I consider that success or failure of many electric light companies now doing central station work is very much dependent on their following or neglecting the proper rules for distribution, and I will illustrate the importance of these rules by a few examples:

1. A plain network by the two-wire system, fed at the central station with the economical size of copper conductors according to Sir William Thomson's laws—say of 1,000 amperes per square inch—and going to a distance of 480 yards, would have a difference of pressure to which the distant lamps would be subjected, of 24 volts.

2. On the three-wire system this would be 12 volts with one-fourth extra copper.

3. With the same amount of copper as in the last, properly arranged with feeders, the feeding points being 160 yards apart, the maximum variation of pressure in any lamp over the district is 2 volts, if the pilot wires come from the feeding centers.

4. Everything remaining the same as this last, except that the pilot wires are placed in the proper position instead of at the feeding points, the maximum variation is only 1 volt.

Putting it in other words, the quantity of copper required to limit the variation of pressure over the district to a certain figure is in the last case one-twelfth part of what it is in the second case, and one nineteenth part of what it is in the first case.

HIGH PRESSURE DISTRIBUTION

Before I leave the question of distribution let me now apply the same rules to the Gaulard and Gibbs system of using alternating currents with high pressure in the mains and low pressure in the houses, the reduction in pressure being effected by means of an induction apparatus called a "converter." At the present moment these converters are usually put in parallel upon the mains. There is a general impression in this country that it is not necessary to have feeders supplying the mains, even though the distance extends to several miles. Here, again, the experience of other countries has been set at defiance, although in a large town like London the importance of this rule is greater than in most American cities, or in Rome. If such views continue to be adopted, the result will be as disastrous in the future as it has been in the past In the most extensive system in this country, when there is a large demand for current, the distant lamps look like red-hot hairpins, even though the near lamps be at full brightness. This is due to defective distribution.

As already stated, there is a general belief in this country that to whatever extent the Gaulard and Gibbs system is used no trouble comes from variations of electric pressure over the district, even when the converters are placed in parallel Let us look at this question a little closer. Returning to the two wire system for low pressure, if we use 1,000 amperes to the square inch as the economical section for our conductors, the fall in pressure is 5 volts for 100 yards the loss of pressure due to the house wiring amounts very generally to 2 volts hence the total variation between the periods of maximum and minimum output is 7 volts per 100 yards, or about double what is permissible (4 volts), hence with the two-wire system such a size of conductor at 100 volts pressure could only be used for a distance of from 50 to 70 yards. Let us see how this distance is extended by using a pressure of 2,000 volts in the mains and [illegible] volts in the secondary. With the same density of current the loss of pressure in the house will be now 5 volts for 2[illegible] yards to which must be added 2 volts for the

house wiring and about $1\frac{1}{2}$ volts for loss in the converter, making $8\frac{1}{2}$ volts loss of pressure in 2,000 yards.

If we allow 4 volts variation in the lamps, which is quite a maximum, this allows only $\frac{1}{2}$ per cent variation in the mains, and then the greatest distance to which conductors can extend is 200 yards. The only means of extending the district is by the use of feeders. In America the practice prevails of allowing only $\frac{1}{2}$ per cent loss of pressure in the mains. I have taken a concrete case of 1,000 amperes per square inch, which may not always apply to actual conditions, but it shows the necessity of adopting the universal foreign practice of employing feeders, even with high-pressure mains.

INSULATION.

We have now to consider a very important, and perhaps the most difficult, part of the problem of central station lighting: how are we to preserve our insulation. It must be noticed that we do not require a high insulation for the sake of getting a small loss of current; but only because with many insulators the high insulation is more permanent, and permanency is the quality of insulation which is most to be desired. I am not going to discuss at present the whole question of insulation, but rather to draw conclusions from the experience of the past. At the present moment vulcanized India rubber and okonite are the substances which have the highest reputation for durability and high insulation under all conditions. These, like other cables, are sometimes covered with lead, but in their case it is only as a mechanical protection, especially during the process of laying, because the destruction of the lead would not destroy the insulation. Of late years a class of cables has been much praised, about which I wish to speak. The copper conductor, stranded or otherwise, is covered with any fibrous material, preferably jute, impregnated with bituminous oils. This covered core is inclosed in the lead pipe. In this class of cable the insulation depends upon the lead being watertight. We all know of many places where this type of cable has done good work for a limited time, and many of us were inclined to believe that it was quite satisfactory, but I think I am right in saying that none of us know of its having worked successfully in any place for three or four years. I have said that a cable of this kind has hitherto been exclusively used in Berlin, the lead being covered with layers of tape or braid soaked in a preservative compound, and the whole armor-plated with two closed spirals of iron ribbon. I regret to have to tell you that this insulation has been a failure. It goes on well enough for about three years, then the lead gives way, the covering on the copper is permeated, and chemical or voltaic action sets up in the copper, which itself becomes disintegrated. So far as experience goes, this type of cable seems to me to be unsuitable for permanent work with the electric light. I trust that in the discussion we shall have some facts brought out. I had hoped, from what Berthoud and Borel, and also Waring, had done, that this would not be so, but the Berlin experience leads me to think otherwise; and on looking through the testimonials of makers I do not find that these cables, when placed underground, have ever worked electric light circuits beyond the three years fixed by the Berlin people as being destructive. I have been told, but I cannot believe it, that there is one company in London actually proposing to put such lead-covered cables without covering into iron pipes. Of course, every one knows they would soon be eaten into by galvanic action.

At Berlin and elsewhere I believe there is the intention of trying some modification of the system of using bare conductors, first practically used by Mr. Crompton at South Kensington. Taking economy into account, it is probable that for low tension circuits this is an admirable plan. It is probable that it may also be adapted to high tension circuits by using oil insulators to support the bare conductors. When copper strip is used it is necessary to raise the cover of the trough in order to increase the number of conductors; this is very expensive. For my own part, I would prefer a drawing in system, if it were otherwise equally good.

At the present moment it seems to me that the only types of underground cable proved suitable for permanent work are either bare copper supported on insulators, or else vulcanized India rubber, or perhaps okonite. Especial care must be taken to avoid an insulator which is injured by the gases which permeate the soil of a town, or which has the property, like pitch, of becoming viscous, and so letting the copper become decentralized.

METERS.

The next lesson which the experience of foreign stations in Europe and America has taught us is the importance of charging the consumers of electricity by meter, like gas. I find that at present most companies in this country are charging the large proportion of their consumers by contract making an annual charge for each lamp. This appears, from evidence collected everywhere, to be a fatal mistake. It is the universal experience that those stations pay best where meters are used. In many stations it is found to be the best plan to make a fixed annual charge, which may be put down as the rent of meter, and then an additional charge proportionate to the quantity of electric current supplied. This has the advantage of preventing customers putting in place a large number of lamps which during the greater portion of the year are idle, but which on festival occasions may all require current. Such idle lamps are very expensive to the suppliers, because a large reserve of machinery must be lying idle during the whole year to be ready for such occasions.

Within the last month I have described before the Society of Arts the different meters which are valuable, without pretending to estimate their relative value. For continuous currents we have the Edison and Aron meters, for alternating currents we have the Schallenberger meter, and for both classes my own "Windmill" meter.

CONVERTERS.

The induction apparatus used with alternating currents is called a "converter," "secondary generator," or "transformer." [illegible] pressure from the [illegible] the secondary [illegible] is generally 20 to 1. [illegible] [illegible]. A large number of types [illegible] have [illegible] the Westinghouse [illegible] which I [illegible] tested and found to be [illegible] though [illegible] the [illegible] only for [illegible].

Only the larger size of Zipernowski converter is so efficient. [illegible], varying [illegible] down to 88 per cent., though the latter is a converter suitable for [illegible] lamps. Many of the types [illegible] are made in England I feel sure are far from efficient. [illegible] is a general opinion that the loss in the converter is necessarily small. This is by no means the case. A great deal of care must be taken in the design to get a satisfactory result. I think there is a general [illegible] any of the converters now on the market in England will give an efficiency for the average number of lamps in circuit of [illegible] to 95 per cent. I should be [illegible] surprised if there are more than two types in use in this country which have an efficiency for the average number of lamps over 70 per cent. Yet, so far as I am aware, [illegible] maker in this country ever tests the efficiency of the converters which he supplies. The efficiency of a converter falls when it is underloaded. If the converter in a house is adapted for 100 lamps, and only three or four lamps are in use, then, with many converters, the current which is being used is double or treble what is required for the lamps. This defect in some converters is clearly shown in the load diagram of the Grosvenor Gallery installation, where during the hours of minimum supply the current sent out from the station is seen to be abnormally high—far above that of the load diagram of other central stations—and at the hours from 4 to 6 A. M. in October current sufficient for 4,000 lamps is indicated on the station meter. This curve shows a loss of 20 per cent. The type of converter which Westinghouse has perfected is one of low magnetic resistance. The worst ones now being made in England are of high magnetic resistance. The waste in a converter, independent of magnetic friction, varies as the square of the magnetic resistance. The waste due to magnetic friction varies as the length of the magnetic circuit, if the induction in the iron is the same. These high magnetic resistance converters require a great deal of copper. The magnetic friction is so great that they would probably work better with an open magnetic circuit, as shown by Lord Rayleigh.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 6.—The recent explosion in the Broadway subway is being investigated by the Board of Electrical Control. Last Monday the representatives of the gas companies were summoned before the board and questioned as to the condition of the mains, etc. Experiments will be made under direction of the board in ventilating the conduits by means of small pipes leading from the subways to tops of electric light poles. It is estimated that from 15 to 20 per cent. of gas manufactured in this city is lost through leakage in distribution, and it is fair to presume that much of this finds its way into the subways. Pending the result of the investigation of the Board of Electrical Control on this subject the attention of the public is temporarily diverted by the action of the Western Union Telegraph company, which is fighting the board. An injunction was obtained restraining the board from interfering with the Western Union company's wires or poles. General Swayne, in his argument before Judge Wallace on behalf of the company, said: "We occupy the highways and streets of the state and city in accordance with the adjudication of the state. The law makes us owners of an interest in the soil. We do not violate the law. We exist under the same circumstances as does the elevated railroad. We have acquired real estate as they have. In fact, having the rights I speak of for over twenty years, we are beyond the reach of the Board of Electrical Control or anybody else, according to the statute of limitation. But we do not take advantage of this statute."

Mr. Bowers, for the Board of Electrical Control, told at some length what the Western Union people should have done and what they did not do to conform with the law. In 1886 they got permission from the Manhattan Railway company to string their wires in the structure of the Sixth avenue road on condition that they would remove the poles along the line. They strung the wires, but never took down the poles. He presented affidavits from various people, which went to show that the conduits in the subway on Sixth avenue were in good condition at the time. Notwithstanding this fact, the Western Union people refused to take down their wires.

Gen. Swayne said that as long as the company operated its telegraph system according to privileges given to it by the United States Government, he could not see by what right the Board of Electrical Control, a state creation, could interfere with the system. "This petition," he said, "is to preserve the status quo of the corporation until a maturer presentation can be had before the court."

Assistant Corporation Counsel Dean said in reply: "We do not dispute the rights the Western Union possess under [illegible]

[illegible]

The [illegible] the public is deeply interested.

[illegible] his influence felt at Albany, where he is having an inning with the Legislature.

The long distances which separate the principal business quarter from the districts in which the people find comfortable residences, require a system of rapid transit for the development and expansion of commercial enterprise which characterizes the metropolis. It is only a few years ago that the surface railroads became inadequate, and the elevated roads were then introduced. Now that there is need of another advance, there is strenuous opposition, as was the case in the former improvement. The operations at Albany are hindering an important undertaking in which all have a deep interest, and it would seem that there is no hesitancy or scruple against using corrupt means for defeating the present bill.

In connection with the question of lighting the streets, an important point has been raised by Mayor Grant. Seven of the companies procured from the Board of Aldermen on May 31, 1887, the right to put up poles and string wires in the streets on condition that each should furnish the city one light free for every fifty arc lights it supplied to private persons. Mayor Grant directed the secretary of the Gas Commission to ascertain and report whether that contract had been fulfilled. T.

Philadelphia, Pa.

PHILADELPHIA, April 6.—The Delaware lawmakers are after the telegraph companies, to make them pay a tax of $10,000 per annum. New Jersey legislators are casting fierce looks at electric light companies and corporations, as though they were inclined to make them pay handsomely for the privilege of existence. Considerable agitation is created at times in the Pennsylvania legislature over projects or schemes to tax heavily strong companies and corporations, but these little squalls will not hurt much.

Pennsylvania will soon boast of a town that will rival Pullman. Its name is Wilmerding. It is [illegible] about fourteen miles east of Pittsburgh. The first outlay for buildings, houses, shops, sewers and plants of all kinds, will be about $6,000,000. It is to be the great workshop of the Westinghouse interests. The electric light plants there will be perhaps on the greatest scale of any on the continent. Eastern capital is crowding into Western Pennsylvania. Its petroleum possibilities are improving. New natural gas wells are struck. There is an improving demand for its coal. Its machinery is finding its way into all parts of the world.

A new motor was tried on Friday on [illegible] branch of the People's line. The motor [illegible] from Dauphin to Mt. Airy, up all hills, with two stops, in twenty minutes, or in about half the usual time.

Builders talk of building [illegible] will not stop short of [illegible], at least. [illegible] be equipped with electricity. [illegible] about extreme activity in the way of [illegible] has over [illegible] other can [illegible] up its new [illegible] [illegible] taking [illegible]

[illegible] It has [illegible]

[illegible] all, even should [illegible] all their wires [illegible] system works [illegible] finished light [illegible] Westinghouse incan- [illegible] Westinghouse [illegible] a contract for [illegible] South Amboy, and [illegible] and will put [illegible]

[illegible] lison Electric Light company have placed their [illegible] better under than [illegible] e ground. To be sure they have trouble, but they are [illegible] At [illegible] and about [illegible] for which they [illegible] They have in [illegible] that do the work [illegible] They contemplate [illegible] the city from all quarters. D.

Denver, Col

[illegible] theater is to be built at the corner of Eighteenth street and Broadway. It will be six stories in height, and will be fireproof throughout. The dimensions will be 86x140. It is said that it will be one of the handsomest theaters in the United States. The cost will be about $250,000. The building will be lighted [illegible] light plants in the country, which will consist of at least three dynamos and two engines, either of which will have capacity to run the [illegible] plant, and two safety boilers. The arrangement of [illegible] and proceed from the [illegible] ctural features designed to receive them, and from the rich plastic relief decorations, which will be a principal feature in the decorative part of the interior. The stage will be separated from the auditorium by a brick fire-wall and brick arch over the proscenium, the asbestos fire curtain running in iron grooves and hung with steel wire ropes and operated by an electric motor.

[illegible] contains the following: "The Denver [illegible] Cable Railway company is having constructed, it is stated on competent authority, an electric motor upon a patented plan made by a Colorado Springs man, which, if it works, will revolutionize the rapid transit systems now in vogue. The only principle of especial importance which is applied by the new motor is that of storage of electricity [illegible] that it will run twenty-five [illegible] thirteen miles an hour without the electricity being recharged, and this can be done in a minute or two from the central supply station. The car is being built, it is said, by Hallack & Howard, but so secret [illegible] construction kept, that [illegible] get any reliable details. [illegible] company will utilize the [illegible] in connection with the cable system, and [illegible] passengers at a speed that [illegible] has taken inside out with [illegible] L.

Detroit, Mich

[illegible] Mich., April 5 —Superintendent Forbes of the Telephone Construction company says it will scarcely [illegible] against the [illegible] underground. Mr [illegible] years we [illegible] Whenever [illegible] oppose the [illegible] the way in [illegible]

go underground first, I see no reason why they shouldn't" There are [illegible] to the telephone company R.

DETROIT, April 6.—Articles of incorporation of the National Electric Traction company were filed with the county clerk this week. The capital stock is $100,000. The object of the company is to manufacture and deal in all articles used in the construction, equipment or operation of electric railways. The stockholders are W. A Jackson, Hugh McMillan, W. H. Wells, C. Warner, C. Corbett, F. Marvin, G. H. Lothrop, F. A. Forbes, B. B. Mitchell, J. L. Talbot, Hi [illegible] Bak [illegible] Nicol

The question of underground wires is again agitating the city counselor, and he proposes to take the question to the higher courts for adjudication. In suits just instituted against the Telephone & Telegraph Construction company and the Western Union Telegraph company, the City of Detroit, and Board of Education aver that in many of the streets the Telephone company has erected poles from 20 to 40 feet high, on which a network of wire is strung. In many cases, it is stated, the wires are in cl se and dangerous proximity to electric light wires, and in many other cases are so thick as to interfere with the work of firemen in case of fire. The court is asked to compel the company to abate the nuisance C.

Utica, N. Y.

UTICA, N. Y., April 6.—An explosion occurred in the Utica Electric Light Works last evening. Heretofore an eight-inch pipe 70 feet long has carried the steam from the boiler house to the engine. A larger boiler had been put in, necessitating a twelve inch pipe. The latter had just been put up, some of the joints being held by only two threads. About 80 pounds of steam were let in last night, when the pipe burst in several places. A portion of the boiler house roof was blown off. The whole plant was filled with steam. The explosion was heard some distance, and stories of a large loss of life spread rapidly. The engineer and two others employed about the building, however, are the only ones injured, and they are suffering only from slight scalds and bruises. The electric lights are out to-night. N.

Indianapolis, Ind.

INDIANAPOLIS, Ind , April 6.—The board of aldermen is at a loss to know what action it should take in regard to the wires of electric light companies furnishing incandescent lights. Some time ago an ordinance was passed requiring all companies of that character, except the Brush, to place their wires underground. At the time the ordinance was passed several companies were asking the right to come into the city, and one, operated by C. C. Perry, had already established a plant, and was furnishing light for quite a number of buildings. Mr. Perry has been extending his service since the passage of the ordinance, and recently the complaint was raised that he did not comply with the ordinance, as all his wires are strung overhead. The complaint has resulted in two new ordinances being introduced in council, one of which proposes to grant Mr. Perry the privilege of keeping his wires as they are, and the other is to compel all companies, including the Brush, to put their wires underground. If this is done a number of outside companies asking to come into the city will remain away from the city, but the council now hesitates about sanctioning the indiscriminate hanging of the wires. The companies, including those already operating incandescent plants, say they cannot afford to continue in business in case they are compelled to put all their wires underground. H.

St. Paul, Minn.

St. Paul, Minn., April [illegible] Allen & Co. have brought [illegible] for an injunction against the St. Paul District Telegraph company, and [illegible] B. C. Leveridge, E. H. [illegible] Petronelia Leveridge, J. M. Alexander and [illegible] All the parties concerned, except [illegible] stockholder in the St. Paul District [illegible] The complainants say that they [illegible] of the company's stock, and that a [illegible] to freeze them out. On [illegible] against the company for [illegible] notes, one of them for [illegible] a Leveridge, who is a [illegible] The indebtedness was [illegible] the complainants' tory. [illegible] for $2,751.76 and [illegible] property of the telegraph [illegible] notice of its pro- [illegible] judgment be [illegible] the Petronelia [illegible] restrained from

selling the property. The sheriff has, however, sold it. Petronelia Leveridge's bid of $3,500 was accepted yesterday, and the property now belongs to her.

Last Saturday the first rails for the electric street car line were unloaded at Stillwater, President E. S. Brown taking off the first rails and putting them on wagons This means that the railway is an established fact, and that the Stillwater hills will become as pleasant as any level city, while retaining beauty of which but few cities can boast. The first work will be done at the corner of Third street south and Burlingham, proceeding not only along Third but also along Burlingham for a few blocks. The latter street is not yet graded, and the work will be delayed to see what the city will do. The poles will be put in position at once, and work will be pushed to have the line open by June 1st. M.

Cleveland, O.

CLEVELAND, O., April 6.—A transcript from the Common Pleas court of Richland county was filed in the office of the clerk of the United States Court Thursday morning by the Mansfield Electric Street Railroad company against the firm of Neftel & Cothout. It is claimed that the Street Railroad company on April 22, 1887, entered into an agreement with the defendants, by which the latter were to furnish the necessary engines, boilers, dynamos, poles, wires, etc., for operating a street car line one and one-half miles long for the sum of $70,000 in bonds of the company secured by a mortgage on the road. The road was to be completed by July 1, 1887, and the plaintiffs claim that only a portion of the road has been built, though the defendants have received full pay under the contract. The suit is brought to secure the sum of $15,000 for the failure to complete the road as agreed, and for other causes stated. M.

Pittsburg, Pa.

PITTSBURG, Pa , April 6.—A dispatch from Harrisburg says: Arguments were heard in the Dauphlin County court to-day in the Commonwealth case against the United States Electric Lighting company, the Northern Electric Light & Power company, the Scranton Illuminating, Heat & Power company and the Excelsior Electric company of Harrisburg. Payment of tax on capital stock is resisted on the ground that these are manufacturing corporations, and consequently exempt from taxation. H.

THE ELECTRIC LIGHT.

Another Brush incandescent light plant has just been sold for use in Menominee, Mich.

The county buildings at Rochester, N. Y., will soon be illuminated by the Thomson-Houston company's system.

A No. 7 Brush dynamo with complement of lamps has recently been furnished to the Union stockyards of Chicago

The New York store, of Chicago, has installed a 16 arc light plant furnished by the Van Depoele Electric Manufacturing company.

The Bessemer, Ala , Electric Light company has started its new plant, consisting of 60 Van Depoele arc and 500 Van Depoele incandescent lights.

The Edison Light company of Elgin, Ill., have purchased a 40 light Van Depoele arc light plant, to be run in connection with the incandescent plant.

The Van Depoele Electric Manufacturing company of Chicago is shipping a new 40-light arc dynamo to the city of Elgin, Ill., an increase to the city lighting plant

A few weeks ago the Brush Electric company of Cleveland, Ohio, received a cablegram ordering two No. 7 arc dynamos, dials, etc., to be shipped to South America.

The Van Depoele Electric Manufacturing company of Chicago has contracted with the city of Titusville, Pa., for a 60-arc light plant for lighting the city. Plant will be in operation in thirty days

Electric lighting seems to be growing in favor in Denver, as one of the local companies there not long since placed an order for two Brush arc dynamos, each having a capacity of 65 lights of 2,000-candle power.

The directors of the Vincennes, Ind., Light & Power company have elected the following officers for the ensuing year: President, J. T. McJimsey, secretary and superintendent, H. W Frund, treasurer, H. A. Foulks.

Alexander Kempt, the Chicago representative of the Brush Electric company, closed the month of March by sending to the home office at Cleveland an order for a 65 light Brush dynamo, with full complement of lamps, dial, etc.

An Oil City, Pa., correspondent writes It is reported on good authority that Oil City will soon have to get along without natural gas as an illuminant. The wherefore is that there is such a heavy demand for it for heating, cooking and manufacturing purposes that the company will be obliged to refuse it soon for illumination. This will be a good opening for the city, and it has concluded to go into the electric light business. The city will supply electric light for the streets, in place of natural gas, to begin

with, and if the gas cannot be supplied longer to light residences and business houses it will at once open up a coveted field for the city's electric light plant.

The Van Depoele Electric Manufacturing company of Chicago has sold to the [illegible] Manufacturing company of Corry, Pa., two 800-light incandescent dynamos and one 50-light incandescent dynamo. The plant is to be installed in the Lakeside Hotel at Chautauqua Lake, N. Y.

If enterprising young electrical engineers want appointments, it would be well for some of them to specially study underground electric light cables, says an English paper, and how to design and superintend the laying of them. There will be plenty of demand for such men soon.

Electric light is a sure go in Charlotte, says a Charlotte, Mich., paper. Haggett & Smith, backed by L. S. Belcher, have ordered two boilers of 125-horse power, an engine of 100 horse power, two dynamos, two car loads of poles, wires, etc., and will have their machinery running just as soon as it can be put together.

The Green Bay & Ft. Howard Electric Railway and Power company, at Chicago—capital stock, $100,000—has been organized to build, equip and operate street and dummy railways in Brown county, Wisconsin, and to supply electric light, heat and power in the cities of Green Bay, Ft. Howard and other places. incorporators, H. Ward Leonard, E. M. Izard and M. L. Coffeen.

Waterhouse arc lighting installations are reported by the Westinghouse Electric company as follows: Central station.: South Omaha, Neb., Electric Light, Heat & Power company, increase of 35 lights, 35 previously installed; Berlin Falls, N. H., Forest Fiber company. 35 lights; Brookings, D. T., Electric Light company, 20 lights. Isolated plants: Philadelphia, Pa., Pennsylvania Railroad company, 70 lights, Cincinnati, O., Weir Frog company, 35 lights.

The committee of the Boston City council, which is investigating the dangers from overhead wires, listened to some interesting statements at a recent meeting. Mayor Russell appeared for the Cambridge Electric Light company, and several of the officers and employes of the company testified. One of the employes had taken a shock from a 500 light alternating current dynamo of 1,000 volts, and another, who had received a number of shocks, said his last shock was from a 1,200-light Thomson-Houston machine of from 2,700 to 3,000 volts. Neither of these men experienced more than an instant's effect. General E. W. Hincks of Cambridge said the overhead system more than meets public approbation; it has disarmed opposition and created a demand that it shall be perfected and extended.

The city of Buffalo, N. Y., was recently restrained from introducing electric lights for public illumination by an injunction granted Anna E. Talcott, a property owner of that city. The complaint raises every conceivable objection to the contract. The history of the resolution, as it made its way through the council, the mayor's veto and the passage of the resolution, notwithstanding his objections, were all given. The claim is made that the petition for the light was not signed by a majority of the taxpayers on the street; that the light will be insufficient, and, finally, that the street will be disfigured and property be lowered in value in consequence. The straw that broke the camel's back was that the price a light, $164.25 a year, was too high. The plaintiff gave a bond of $500 in order to obtain a temporary injunction. This action has created considerable merriment among the residents of neighboring cities, as Buffalonians are boastful of their city's enterprise.

A dispatch from Sedalia, Mo., says: The Sedalia Electric Light & Power company was this afternoon sold to Joseph Green, L. M. Rumsey and other St. Louis gentlemen, who will operate it in the future. At a meeting of the city council Monday night the contract for five years for lighting the city with 100 arc lights was let to the Central Electric Light & Power company of Topeka, Kan., the Sedalia company being one of the bidders The successful company was given until the 10th to file its bond and make a formal contract. Green & Co. will make an effort, it is stated, to enjoin the city from making a contract with the Topeka company on the ground that the twenty-year exclusive franchise granted to the Sedalia company five years ago, is valid, the city holding differently. If the Topeka company fails to complete the terms of the contract the purchasers of the Sedalia company will strive to retain its present contract with the city for lights.

THE ELECTRIC MOTOR.

The Buffalo Common Council has postponed for three weeks the application of the People's Electric Railway company for a franchise.

The Chattanooga, Tenn., Electric Railroad company has given bonds in the sum of $250,000, and the work of construction has been commenced.

The immense building at the Paris Exhibition, the Palais du Machines, for the reception of machinery in motion, is to have an electric elevator in one corner, which will ascend to the height of about 130 feet.

Two new street car companies have been organized at Rochester, N. Y., where the street car franchises have heretofore been monopolized by one company. The new companies, it is reported, may operate their cars by electricity.

The Rudd Electric Rapid Transit company has been incorporated at Chicago; capital stock $[illegible], for the construction and operation of electric railways, either surface, underground or elevated, for carrying express, freight, mail and passengers, and the construction and operation of telegraph lines, electric lights and power, and the manufacture of all kinds of electric goods; incorporators, Joseph L. Holbrook, Harlan E. Patterson, and W. C. Holbrook.

THE TELEGRAPH.

During the recent storm in Dakota the [illegible] between [illegible] Huron.

Another [illegible] telegraph company [illegible] incorporated at Albany, to be known as the [illegible] Telegraph company, and its general route [illegible] Saranac Lake and [illegible] points [illegible] Plattsburgh, New York [illegible] Lake Placid. The capital is $[illegible].

A Winnipeg, Manitoba dispatch says: [illegible] entered the [illegible] the Canadian Pacific [illegible] express company at Indian Head, at midnight last night, placed a revolver at the head of W. H. Ross, the telegraph operator in charge, and demanded the money in his keeping. Ross suddenly blew out the light, and opened fire with his own revolver. The robbers made off without getting any booty.

A Chicago paper publishes the following dispatch from New York: A morning paper says there is [illegible] among the Western Union operators. An operator [illegible] quoted as authority for the statement. At first he positively denied all knowledge of any organization, but after persistent questioning admitted that a union had been formed among the men. He said that the members had been assessed each week for a long time, and that there was enough money in the treasury to hold out for two months, should any trouble occur At the Western Union building the men refused to divulge anything about the matter.

An interesting case involving the liability of a telegraph company for misquoted messages was instituted in the Court of Common Pleas at Toledo last week against the Western Union. In October, 1888, the city of Findlay wanted three miles of six-inch gas pipe, and the plaintiffs telegraphed to the Reading Iron Works asking how much they would furnish the pipe for. The response said 50 cents per foot delivered, and on that basis Shaw, Kendall & Co. bid and were awarded the contract. It was afterward found that the response was 55 cents per foot and the telegraph company had misquoted it. Shaw, Kendall & Co. lost $792 on the contract; hence a suit to recover from the telegraph company.

Charles G. Burke of New York has completed his cable system, by which he hopes to greatly facilitate the present operations. Mr. Burke will visit Ireland soon for the purpose of putting in the instruments on the direct cable to test the system between Ireland and America on the long end of that cable. Between Canso, N. S., and Rye Beach, N. H., in testing the Burke apparatus, there was practically no difference between the working of the cable and an ordinary city wire. On this circuit the "mirror" is in constant use. The substitution of the Morse sounder for the "mirror" and "recorder" will increase the speed. If the system proves a success the carrying capacity of the Atlantic cables will be greatly augmented. At the same time, success in these experiments means an earlier start in the laying of a Pacific cable. One of the drawbacks to the latter enterprise now is the great stretch of cable necessary to connect the two continents, over which some electricians express the belief that it will be with much difficulty to exchange any of the present systems of cable signaling.

In the suit of the Commonwealth against the Western Union Telegraph company, an action to compel forefeiture of the company's charter for alleged consolidation with the Baltimore & Ohio Telegraph company, a motion was made at Harrisburg, Pa., recently for a change of venue. Silas W. Pettit and M. E. Olmstead, for the Western Union, presented the pleas, and also a petition for removal of the suit to the United States Circuit court at Philadelphia. Similar pleas and petitions were presented by counsel for the Baltimore & Ohio company. Attorney General Kirkpatrick opposed the removal. The Western Union denies that it or the Baltimore & Ohio is subject to the constitution and laws of Pennsylvania. It admits that it has acquired substantially the whole stock of the Baltimore & Ohio Telegraph company, but that it has not consolidated with the said company. It further denies that it holds any part of the capital stock of the Baltimore & Ohio Telegraph company of Pennsylvania, or that it at any time consolidated with said company. It further says that the Western Union Telegraph company is incorporated for telegraph purposes under the laws of New York, with power to construct and operate lines by telegraph, and to sell its own property, or to acquire that of others. The case will be argued April 17th at Harrisburg.

Miscellaneous Notes.

The city council of Chicago is considering the petition of the P. C Hanford Oil company for permission to lay pipes in which to conduct oil from Hyde Park to Seventeenth street

The Phoenix Incandescent Lamp company, at Chicago, capital stock $[illegible], has been organized for the manufacture of electric lamps and other electrical apparatus; incorporators, A. L. Opperman, F. C. Gott, and [illegible] Eckstromer.

An electrical signaling apparatus has been introduced into the city of Cleveland by the Detroit and Cleveland Steam Navigation company's line. Current is furnished from Detroit storage battery cells, manufactured by the Woodward Electrical Company of Detroit.

A correspondent in Ishpeming, Mich., writes: The situation in the copper districts is better than could be expected, considering the sudden and inglorious collapse of M. Secretan's copper syndicate. Capitalists who loaded up with copper stocks at fancy prices are badly left, and speculators who dealt in margins are extinguished. The mines will make less money than before, but there has been no

[illegible]

moneys which are alleged to be held for the [illegible] sugar company.

[illegible]

iron from the earthy imperfections. The operation [illegible] now being erected, and operations will soon be begun.

"The lately published opinion of the postmaster-general of England, that an underground system of electric wires, though advantageous, was 'much more costly than that of carrying wires overhead,' may fail to express fully the difficulties of [illegible] "but if it is a question whether the wires shall stay up or the steam pipes shall come up, we are in favor of the latter. Perhaps after the wires were down, though, they might find that they could live in company with the steam pipes without sacrificing their insulation."

The contract for the annunciator work in the hotel of the Auditorium building, Chicago, has been awarded to the electrical department of the New Haven Clock company, G. A. Harmount, western manager. The Porter messenger will be used throughout the building. Three annunciators will be employed, each one to receive calls from three floors. Each of the 335 rooms has been provided with a Porter call-box. A return call system is used. The Porter messenger was illustrated and described in Vol. III, page 231, of the Western Electrician.

Personal Paragraphs.

F. E. Pettingell of Pettingell, Andrews & Co., Boston, has been spending a few days in Chicago.

Joseph W. Frost, of the National Automatic Fire Alarm company of New York, was in Chicago last week.

S. J. Rosamond of Kansas City, Mo., was in Chicago last week inspecting several systems of electric lighting. Mr. Rosamond represents the Doggett Dry Goods company, an extensive establishment at Kansas City which contemplates installing an electric plant.

General Manager R. T. McDonald, who was quite seriously injured by a falling brick while superintending the construction of the new factory of the Fort Wayne Jenney Electric Light company, has entirely recovered, much to the satisfaction of his many friends.

Business Mention.

Holtzer & Cabot of Boston have [illegible] for wiring the Suffolk county court house for the Edison Electric Light company and the Hotel Ludlow, Boston, for 500 lights. The firm [illegible] an excellent business.

As it has been mentioned in these columns, W[illegible] & Smith have been appointed general agents [illegible] States for the [illegible] These motors, it will be remembered, [illegible] the Cincinnati Exposition. [illegible] they desire to arrange [illegible] resident parties for agencies [illegible] located in the Mitchell [illegible]

[illegible] Co., of M[illegible] following [illegible] "We are [illegible] death of [illegible] The deceased has [illegible]

[illegible]

Chicago agency for the Simplex company. His office will [illegible] 80 Adams street, Chicago. Within the last three [illegible] miles of [illegible] parts [illegible]

[illegible] at 80 Adams [illegible] highly convenient [illegible] Mr. Cutter will [illegible] stock [illegible] pounds of Simplex [illegible] prospect for doing [illegible]

[illegible] of compounding high speed engines are attracting marked attention from [illegible] of higher efficiency [illegible] advantages of compact power driving direct to dynamos or other rapidly rotating [illegible] development, which will be watched with interest, is the use of this type of compound engines without the condenser in localities [illegible] available. It is believed that high steam pressure, expanding through two cylinders, will affect a clear saving that will more than justify the small additional price of compounding. Acting [illegible] manager of the Edison Electric Illuminating company of Brooklyn, and formerly [illegible] Manufacturing company [illegible] for the mammoth central station now being erected at 360 Pearl street, Brooklyn, where the energy of 3,000 horse power will be sent out in electric currents through an underground system radiating nearly a mile in all directions from the station as a center. The engines for this work will be furnished by the Ball Engine company of Erie, Pa., the order having [illegible] New [illegible] agent Messrs. C. R. Vincent & Co., for twelve engines, each of 250-horse power capacity. The general plan of these engines will be of the double horizontal type, with opposite cranks and one high pressure and one low pressure cylinder. Each engine will weigh 30,000 pounds, thus making twelve car loads for the engine equipment of this station. Steam will be [illegible] battery of Babcock & Wilcox boilers, situated on the same floors with the engines. With an electrical outfit embodying all of Mr. Edison's latest improvements in central station work, it is the expectation of the projectors of this enterprise that they will have the most economical and efficient station in the [illegible]

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, reports the following quotations of telephone stocks:

Chicago	300	305
[illegible]	50	51
[illegible]	81	82
[illegible]	31	33
Colorado	39	40
[illegible]	40	41
[illegible]	67	69
[illegible]	116	117
[illegible]	150	153
[illegible]	22	25
[illegible]	69	70

Electrical Patents.

[illegible] 2d, 1889.

[illegible] Galvanic Battery. Edward H. Crosby, Boston, Mass.

[illegible] Myron D. Law, Philadelphia [illegible]

[illegible] S. E. Lawshe, [illegible]

[illegible] Electric Lamps. Alexander [illegible] Mass., and [illegible] N. Y.

[illegible] Nutting, Cin[illegible]

[illegible] Pease, Phila[illegible]

[illegible] m of Electric Distribution. Ed[illegible]

[illegible]

[illegible] partial magnetic [illegible] vered on [illegible]

[illegible] through a path independent, in whole or in part, of the core or portion of [illegible] in which [illegible] developed by the other coil or circuit.

400,520. [illegible] phones. Clarence E. Tuttle, Chicago, Ill.

400,523. Harmonic Telegraphy. Francois Van Rysselberghe, Brussels, Belgium.

400,528. Electric [illegible] aling. William H. Waddell, Lexington, [illegible]

400,552. Telegraph Wire Carrier. Robert S. Donaldson, Wilkinsburg, Pa.

Claim 1 follows: "The combination, with the cross-arms of telegraph poles, of temporary carriers provided each with adjustable sheaves mounted thereon, one at each cross arm, and the wire placed in said carriers between the sheaves, whereby an old wire may be readily drawn out and at the same time the new wire attached thereto drawn into place in long sections."

400,591. Telephone Transmitter. William J. Morton, New York, N. Y.

400,600. Insulating Pipe Coupling. Frederick C. Rockwell, Hartford, Conn.

400,658. Electric Lamp Attachment for Gas Fixtures. Emil L. Gennert, Brooklyn, N. Y.

400,661. Apparatus for Determining Electric or Magnetic Forces. Adolphus Gipperich, Richmond, Va.

The invention relates to determining the value of magnetic or electric or electro-magnetic forces by weight.

A magnetic needle is combined with a scale or balance for weighing the deflections or dip of the needle under the influence of varying magnetic forces, together with a registering device.

The first claim is given: "An instrument for determining the value of magnetic or electric or electro-magnetic forces, comprising a polarized body, a balance, a fulcrum common to both, an adjustable weight on said balance, a register, shifting mechanism for shifting the weight on the balance, and transmitting mechanism for transmitting the movements of the weight to the register."

400,662. Art of Determining the Value of Electric, Magnetic, or Electro-Magnetic Forces by Weight. Adolphus Gipperich, Richmond, Va.

The invention consists in first determining by weight the value of terrestrial magnetism by counterbalancing an equilibrated polarized body as against the influence of such magnetism, and utilizing the value obtained as a standard of comparison in weighing other like forces.

400,663. Apparatus for Determining the Value of Electro-Magnetic Forces by Weight. Adolphus Gipperich, Richmond, Va.

Claims 1 and 9 follow: "1. In a scale for weighing magnetic, electric, or electro-magnetic forces, a magnetized or polarized scale beam.

"9. In a scale for weighing magnetic, electric, or electro-magnetic forces, a magnetized or polarized scale beam and a scale pan suspended from said scale beam at the center of attraction or point of leverage of the forces."

400,664. Process of Reducing Aluminum from its Fluoride Salts by Electrolysis. Charles M. Hall, Oberlin, Ohio.

400,665. Manufacture of Aluminum. Charles M. Hall, Oberlin, Ohio.

400,666. Process of Electrolyzing Crude Salts of Aluminum. Charles M. Hall, Oberlin, Ohio.

The second claim reads: "As an improvement in the art of manufacturing aluminum, the method herein described, which consists in fusing a combination of the fluoride of aluminum, the fluoride of calcium, the fluoride of sodium and the chloride of calcium, adding alumina to the bath so formed, and then passing a current of electricity through the fused mass."

400,667. Process of Electrolyzing Fused Salts of Aluminum. Charles M. Hall, Oberlin, Ohio.

400,669. Safety Device for Electric Circuits. William J. Hammer, Boston, Mass.

The last claim is appended:

"2. The combination, with an electrical conductor, of a safety catch normally in the circuit, a switching device suspended by said safety catch, and a substitute safety catch of greater conducting capacity provided with suitable terminals situated beneath said switching device, whereby upon the breaking of the normal safety-catch the substitute is switched automatically into circuit."

400,[illegible] Prevention of Sparking in Electric Motors and Generators. Dover [illegible] Philadelphia, Pa.

The motor or generator is provided with field magnet [illegible] and counter [illegible] coils on its [illegible]

[illegible] Lamp. George M. [illegible] Asbury Park, N. J. [illegible] repeating electro-magnet [illegible] regulating magnet of an [illegible] the action of the [illegible] ions of current strength. [illegible] in circuit in which [illegible]

[illegible]

400,724. Trolley for Electrical Railways. David A. Ainslie, Richmond, Va.

400,725. Trolley for Electric Railways. David A. Ainslie, Richmond, Va.

400,726. Method of Regulating Electric Currents. Joseph W. Baker, New York, N. Y.

The second claim is:

"The method of regulating electric currents automatically, which consists in conveying the main current or a portion of the main current into storage batteries, so as to absorb the surplus energy of the main current when the main current is too strong to do the work, and cutting out the fully charged storage batteries from the charging current by causing the circuit of the charged batteries to open, and disconnecting the storage batteries from the main circuit when the main current corresponds to the work to be done."

400,732. Electric Switch. Sigmund Bergmann, New York, N. Y.

400,733. Switch for Electric Circuits. Sigmund Bergmann, New York, N. Y.

400,746. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

400,747. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

The claim reads:

"The combination, with a primary apron, of a secondary apron situated over and made to extend in the same direction as the primary apron, a magnetized plate secured in proximity to the secondary apron, and suitable driving mechanism for actuating the aprons."

400,750. Alarm System. Charles A. Cox and Joseph F. Cox, Louisville, Ky.

400,764. Underground Conduit. Patrick R. Greene, Brooklyn, N. Y.

400,766. Process of Reducing Aluminium by Electrolysis. Charles M. Hall, Oberlin, Ohio.

400,795. Spark Coil. Francis H. Root, Chicago, Ill.

The two claims are given:

"1. As an improvement in the manufacture of spark coils, a core consisting of pliable metal strips laid together flatwise, and a winding which is wound to provide gaps or notches, such as set forth, whereby the core may be readily bent and brought substantially within the radius of a circle.

"2. A spark coil consisting of a core formed of pliable metal strips laid together flatwise, and a winding which is wound to provide gaps or notches, the whole being substantially within the radius of a circle."

400,808. Switch Device for Electric Currents. Joseph A. Turner, St. Louis, Mo.

400,809. Alternating Current Electric Reciprocating Engine. Charles J. Van Depoele, Lynn, Mass.

Of the seventeen claims, the sixth is given:

"An electro-magnetic reciprocating engine comprising a motor coil or coils in circuit with a source of alternating or defined electric currents, and an iron plunger adapted to be reciprocated within the coil or coils under the influence of the alternating currents, the mass of said plunger being laminated or subdivided."

400,830. Electric Car. George H. Condict and Victor Angerer, Philadelphia, Pa.

400,838. Dynamo-Electric Machine. Justus B. Entz, New York, N. Y.

The armature carries independent insulated conductors, and is provided with alternate supporting strips, to which are attached collecting rings forming terminals for the said conductors.

400,842. Secondary Battery. William W. Griscom, Haverford College, Pa.

The invention consists in supporting both elements at points on two opposite edges of the plates near the central vertical distance thereof.

Claims 2 and 11 follow.

"2. In a secondary battery, the combination of two elements or electrodes, an inclosing cell therefor, an electrolytic liquid, and means for supporting both said electrodes above the bottom of the cell, consisting of projections located on opposite sides at or near the central vertical distance thereof, and taking against fixed supports within the cell.

"11. The combination of two sections of conducting material, each forming the terminal of a battery, and each provided with a threaded surface combined with a nut having a threaded contact surface for mechanically and electrically uniting the two said sections."

400,843. Distribution of Electricity by Secondary Batteries. William W. Griscom, Haverford College, Pa.

400,862. Secondary Generator for the Conversion of Electrical Energy by Induction. William Lowrie and Chas. J. Hall, London, County of Middlesex, Eng.

The object of the invention is to cause the whole of the magnetic currents circulating through the magnetic circuit to pass through the interior of the coils, while at the same time the length of the circuit is reduced to a minimum, and the magnetic resistance and cost of construction decreased.

Claim 6 is:

"Two or more laminated iron cores of square or rectangular shape without re-entering angles, and having separate coils wound or mounted thereon, combined with [illegible] pieces or blocks adapted to receive the end portions of the cores, and clamping devices to clamp the blocks and cores together in their relative position."

400,876. Electric Condenser. William Marshall, New York, N. Y.

400,[illegible] Railway Signal. Samuel [illegible], Deposit, N. Y.

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194, 196 and 198 S. Clinton St.,

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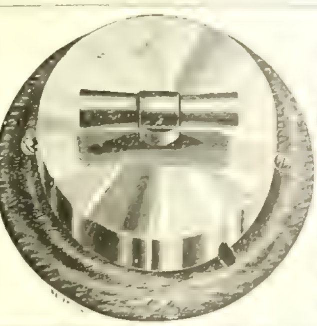

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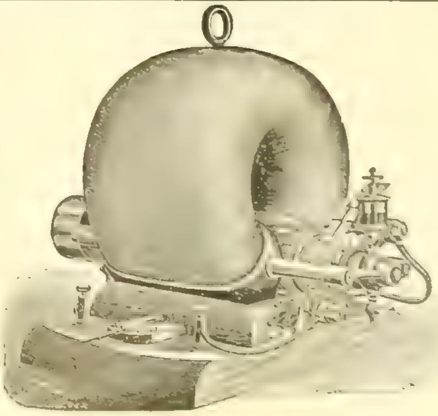

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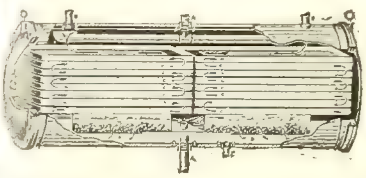

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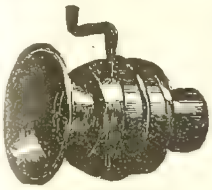

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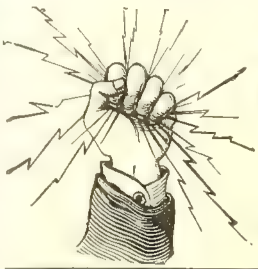

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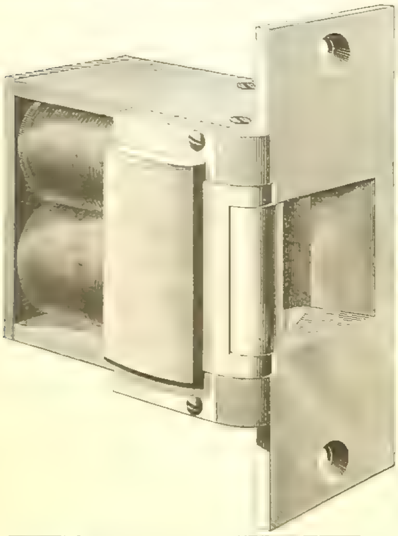

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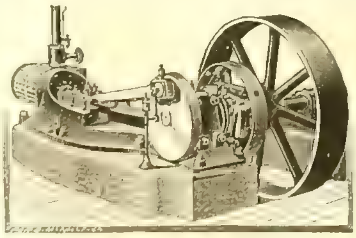

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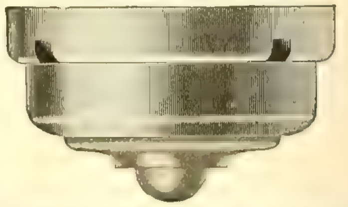

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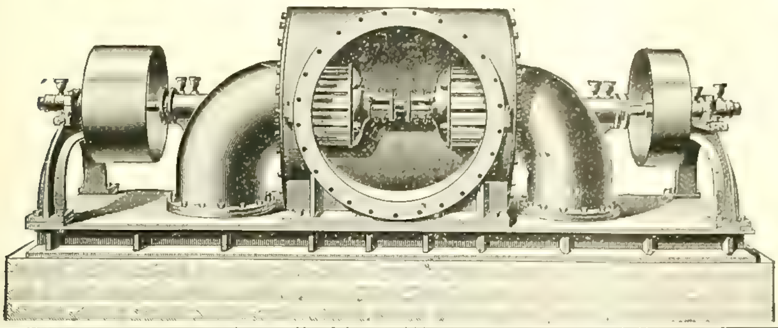

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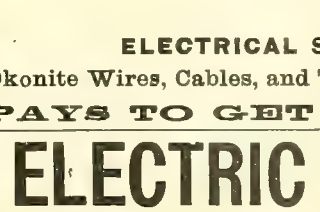

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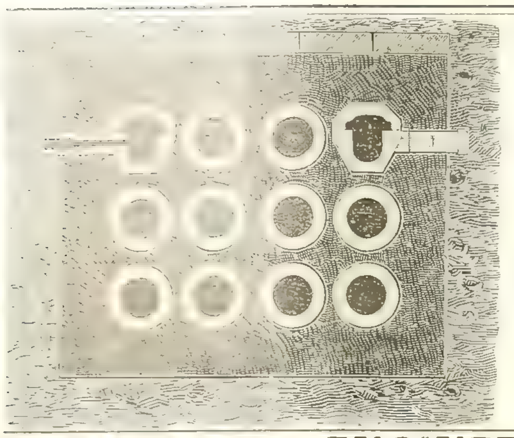

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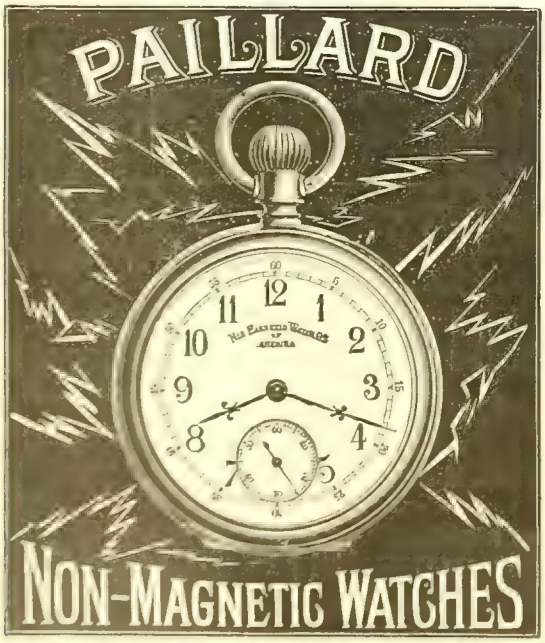

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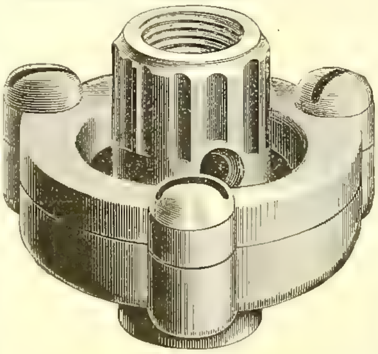

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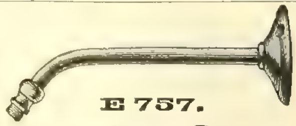

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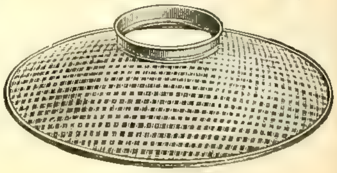

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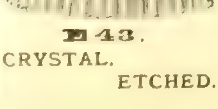

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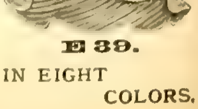

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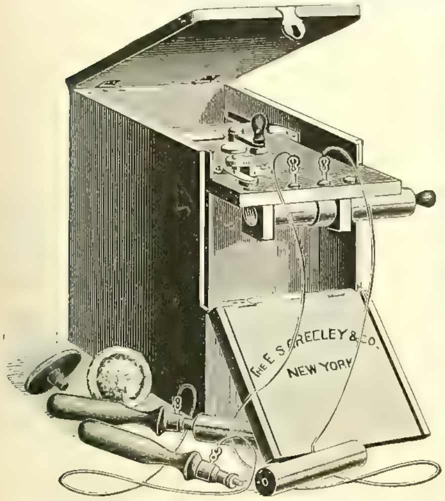

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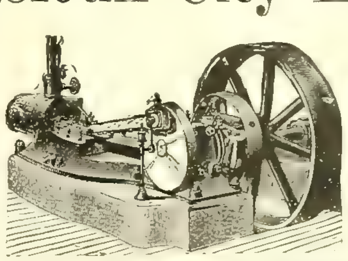

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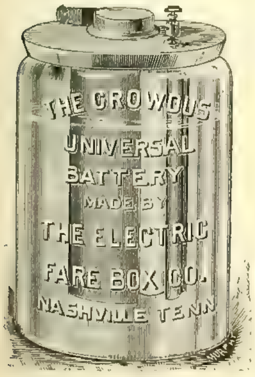

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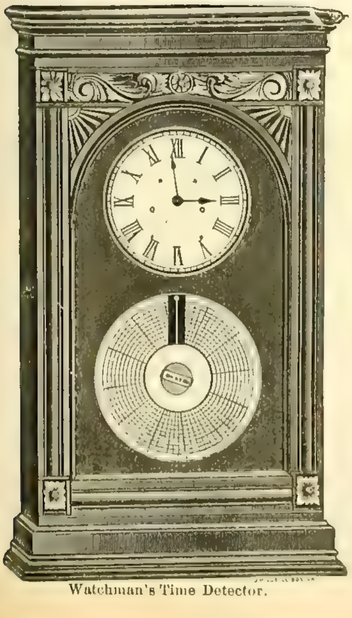

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THE JULIEN ELECTRIC COMPANY

RECENT STORAGE BATTERY DECISION.

Synopsis of the Court's Decision in Judge Coxe's Own Words.

Some controversy having arisen as to the extent of the recent decision of Judge Coxe, in the important case of The Electrical Accumulator Company against The Julien Electric Company, we give below so much of the text of the opinion as is necessary to enable the reader to determine just what the Judge actually decided. As the opinion covers in all 57 pages of type-written matter, we are unable to give it in full.

UNITED STATES CIRCUIT COURT.
Southern District of New York.

The Electrical Accumulator Company vs. The Julien Electric Company and William Bracken. — ***In Equity.***

FREDERICK H. BETTS for the Complainants.

THOMAS W. OSBORN and HORACE M. RUGGLES for the Defendants.

COXE, *J.*:

"This is an action for the infringement of four letters patent, owned by the complainants, for an improvement in secondary electrical batteries. One of these, No. 266,262, granted to Shaw and Rogers, October 17, 1882, has been withdrawn from the consideration of the Court. The three in controversy are No. 252,002, granted January 3, 1882, to Camille Alphonse Faurè, and Nos. 312,599 and 318,828, granted, respectively, February 17 and May 26, 1885, to Joseph Wilson Swan."

The Court, after discussing the general nature of the improvements described in the patent of Faure, said: "The claims in controversy (in Faure Patent No. 252,002) are the first and the fourth."

After a summary statement of the defenses presented by the answer of The Julien Electric Company, the Court says:

"In construing the first claim it should be remembered that it is limited to an improvement upon the well known batteries of Gaston Planté, who was the creator of practical secondary batteries. The art began with him."

The Court next proceeds to discuss the proper construction of the first claim, and after defining its scope considers the proofs of anticipation and prior use offered by the defendant.

"It therefore becomes apparent that the combination of the first claim, construed as it must be construed under the loose and inaccurate language of the specification, is anticipated in every form in which the active layer can be applied, save one—namely, in the form, of a *paint, paste or cement.* The question now to be considered is can the *patent* be *saved to this extent? The application in the form of a paint, paste or cement was the real invention which Faure made.*"

* * * *

"The proof establishes two propositions with equal clearness. First, Faure was the inventor of a secondary battery electrode coated in the manner stated; and, second, he was not the *inventor of an electrode otherwise coated.*"

"If, by means of a disclaimer, the patent can be restricted to the actual invention, this course should, in fairness, be adopted."

* * * *

"What he did not invent was an electrode in a secondary battery coated with a soluble layer of active material, neither did he invent an electrode on which the active material is applied by 'galvanic action or chemical precipitation or otherwise.' * * * *No one will infringe unless he constructs his battery in the one way to which the patent will be confined.*"

* * * *

"After giving the subject the most careful consideration, it is thought that Faure was the originator of the invention just described, and that it would be unjust to him to declare the patent wholly void if he is willing to restrict it to what is lawfully his own."

The Court immediately proceeds to discuss the fourth claim of Faure's patent:

"The fourth claim, if construed to cover the defendants' structure, is void for want of novelty. * * * It is clear that a construction of the claim which is broad enough to cover the defendants' battery renders the claim invalid.

* * * *

* * * A limited construction can, however, be given the claim, which will render it valid."

"The Court then proceeds to discuss the construction of the fourth claim, proposed by the council of The Julien Electric Company, and says:

"In view of these facts, and because the patentee, in effect, disclaimed the construction sought to be placed upon the claim by the complainant, it would seem that the defendants' construction has much in reason and authority to support it, and is the more rational of the two.

"So construed, the defendants do not infringe the claim."

The Court next proceeds to consider the first patent granted to Swan, No. 312,599, and after discussing the construction of the patent and the proofs offered by The Julien Electric Company showing the state of the art and prior use of the invention by other parties, concludes as follows:

"Upon this evidence, therefore, the *first Swan patent must be declared invalid.*"

The Court next proceeds to discuss the second patent granted to Swan, No. 318,828, and after comparing the same with Swan's first patent, says:

"Even if the second patent can be distinguished from the first in the particular stated by the experts, it is entirely clear that the difference pointed out is wholly insufficient to sustain invention. After the first patent, there was absolutely no room for the second patent. * * Swan describes no invention in the first patent which is not covered by the claim of that patent. What is not claimed is not patentable."

"The decision concludes with the following language:

"It follows, therefore, that the complainants, upon filing a disclaimer, limiting the first claim of the Faure patent to an electrode of a secondary battery to which the active layer is applied in the form of a paint, paste or cement, insoluble in the electrolytic liquid, are entitled to a decree for an injunction and an accounting upon the claim as thus limited, but without costs."

It will appear from the foregoing opinion, that no decree has been awarded to the complainants for any relief whatever, nor has any one of the patents been sustained; but on the contrary every claim in controversy is decided to be invalid (except one which is held not to be infringed).

The Court has merely given leave to the Accumulator Company to file in the office of the Commissioner of Patents a disclaimer limiting the first claim of Faure's patent in the manner specified, and decided that, if this condition be complied with, the complainants may have a decree for an injunction restraining infringement of this claim, thus narrowly limited.

The filing of such a disclaimer will operate as a complete abandonment of Faure's chief pretensions, and will limit his patent to a device which the Julien Company does not use and does not desire to use.

The Julien Electric Company does *not* apply the active layer in the form of a paint, paste or cement, but in a wholly different way.

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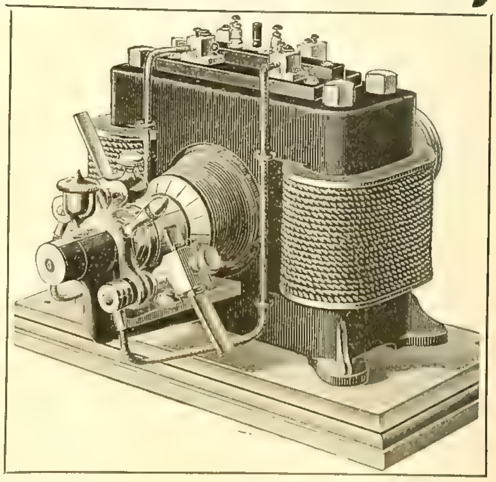

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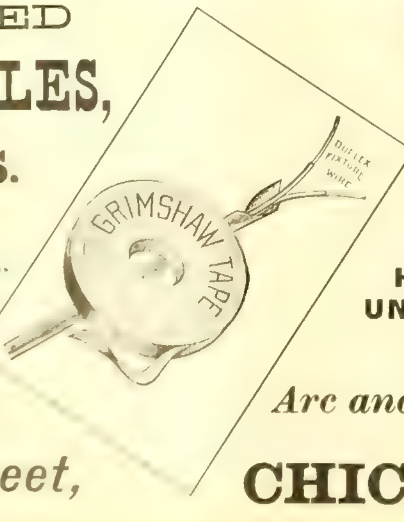

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Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simple a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

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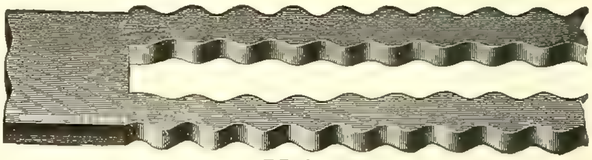

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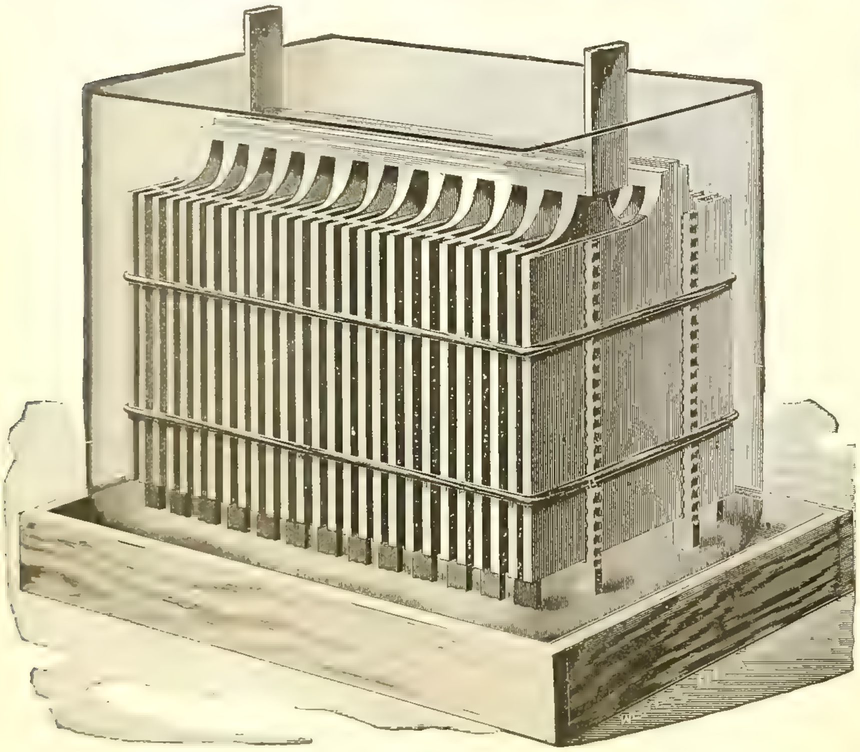

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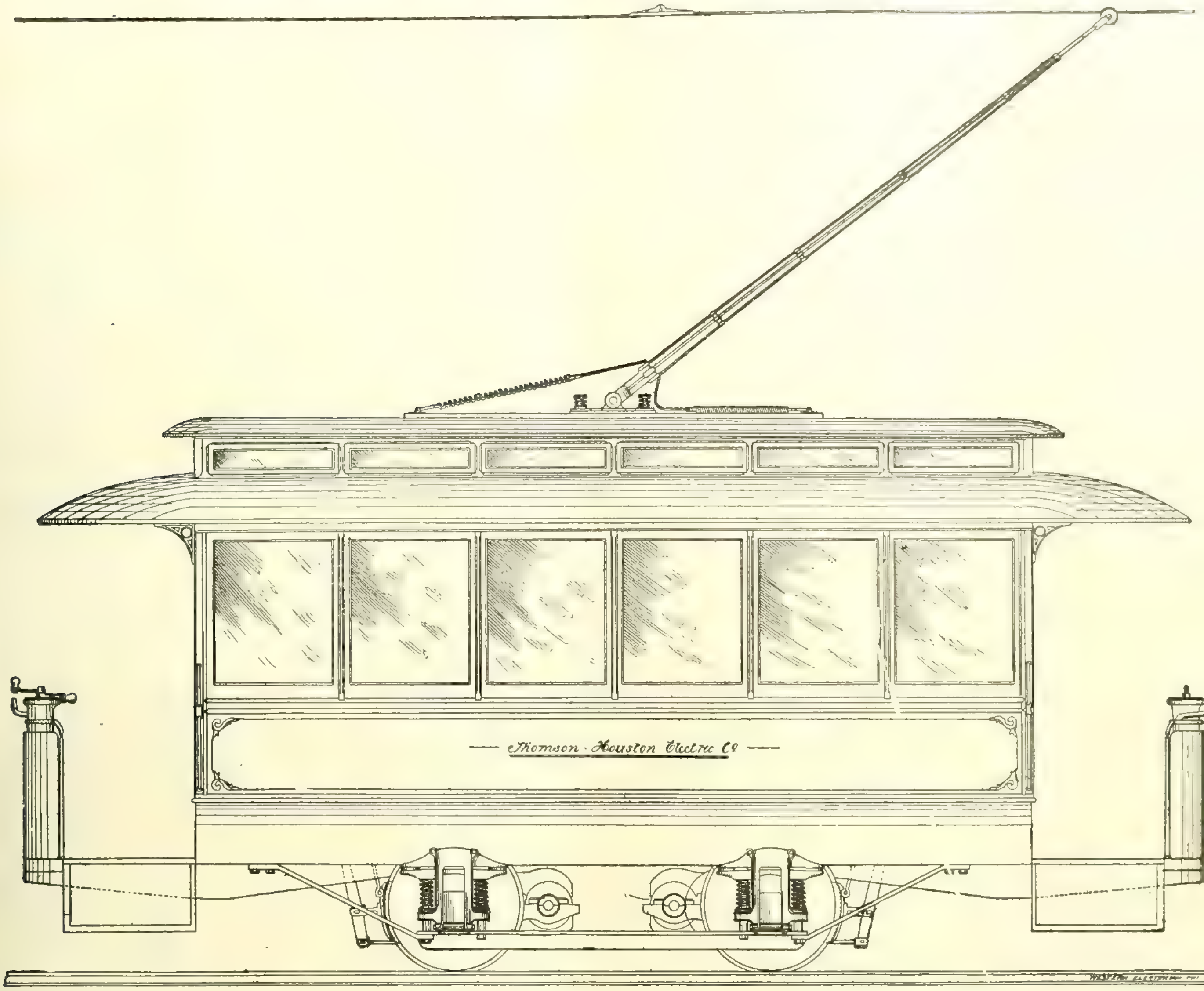

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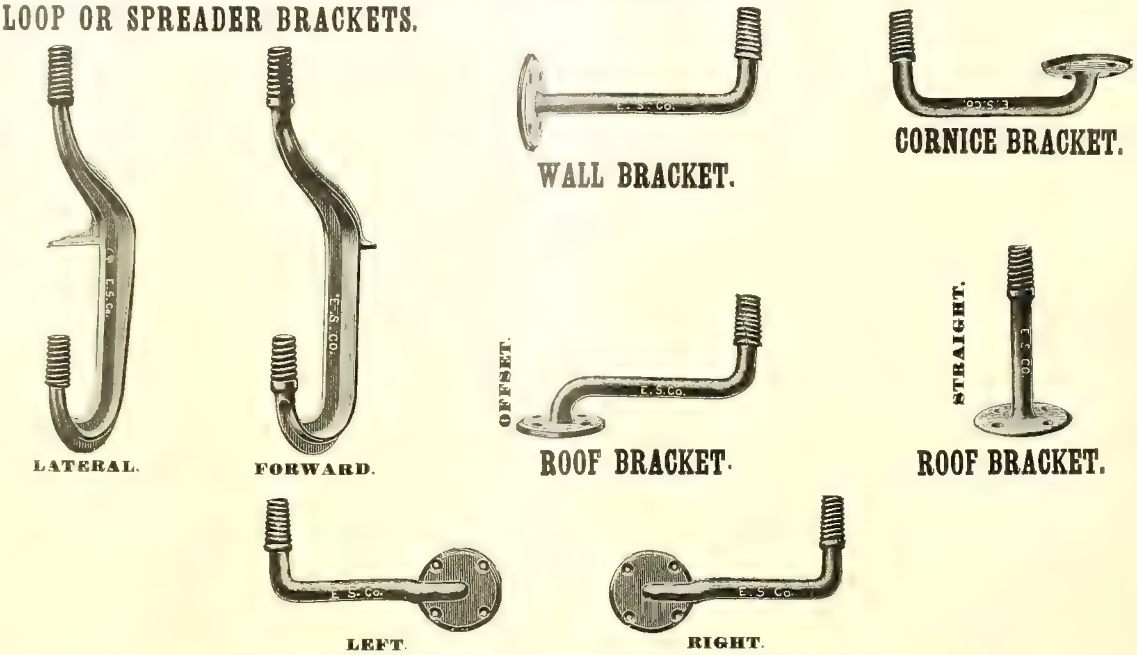

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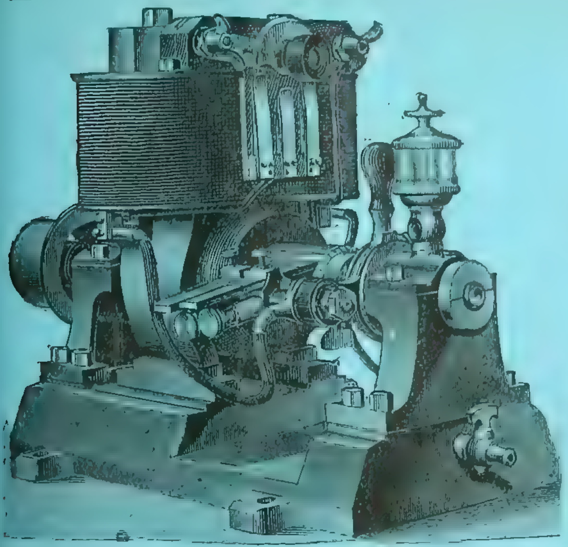

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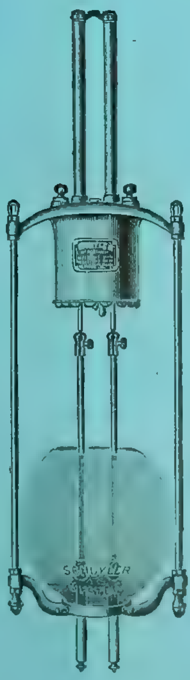

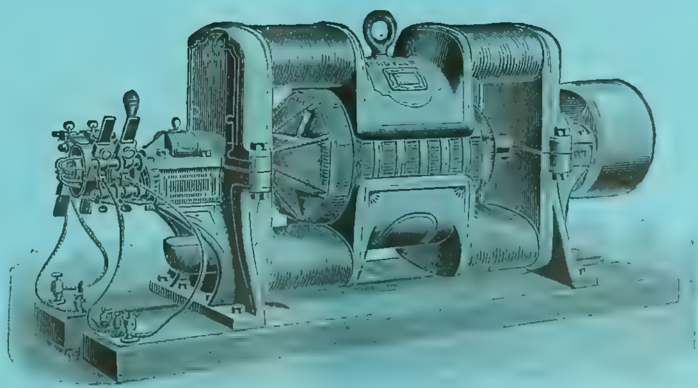

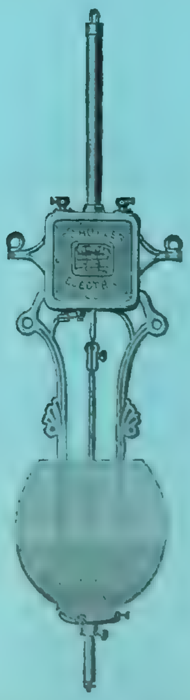

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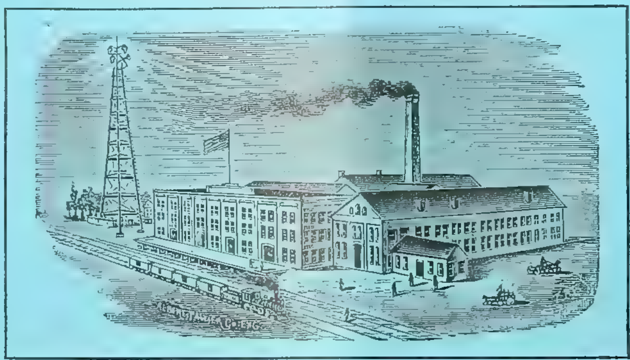

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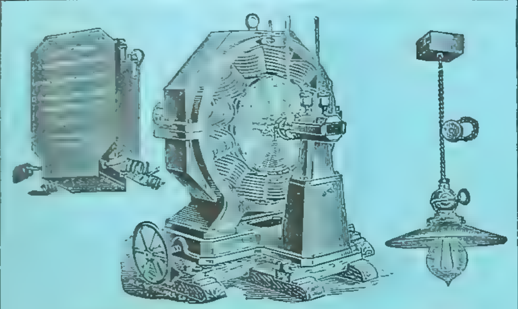

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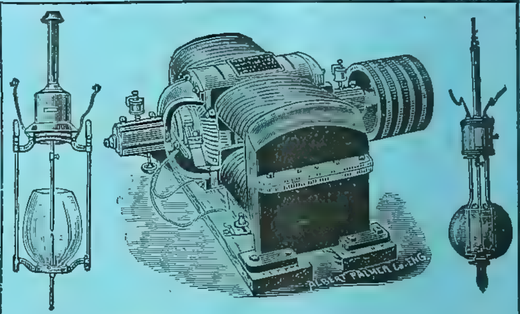

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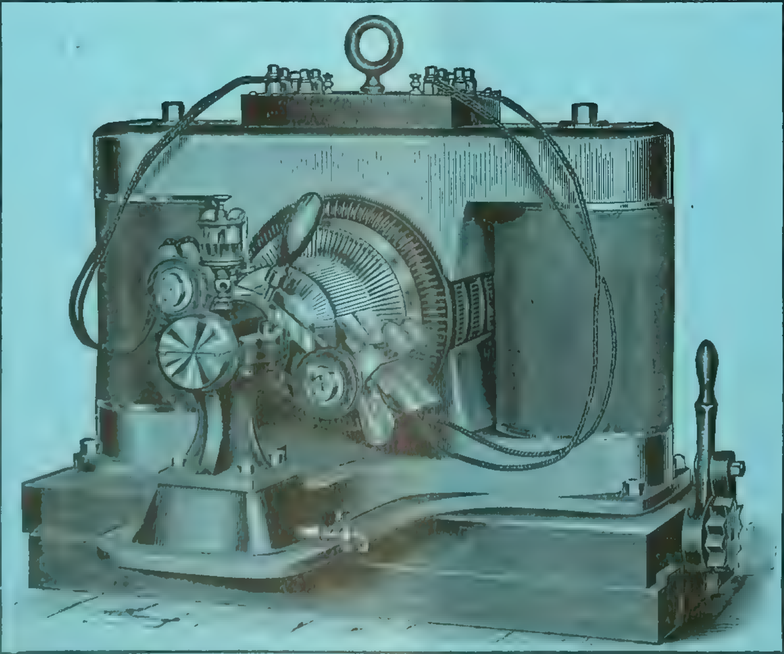

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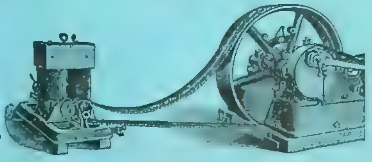

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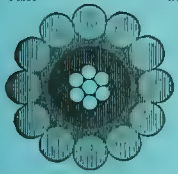

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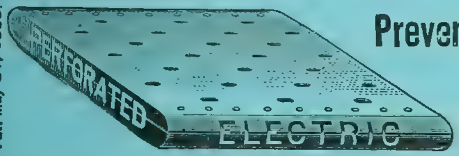

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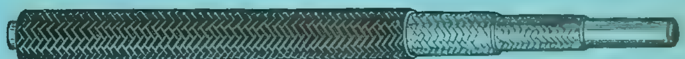

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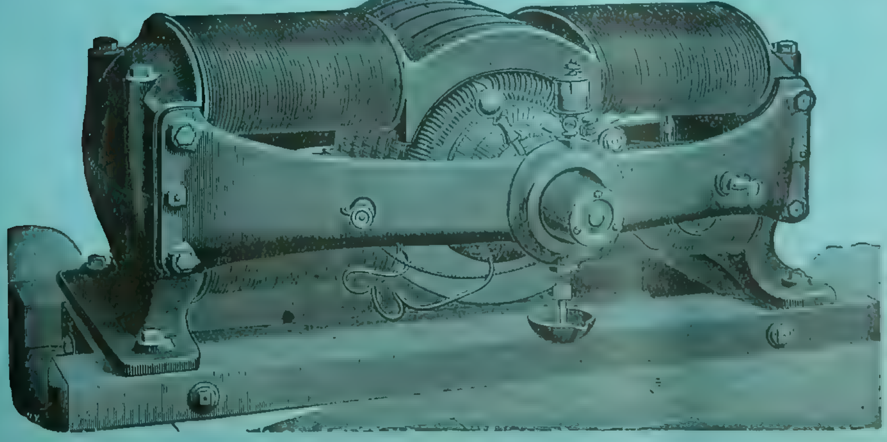

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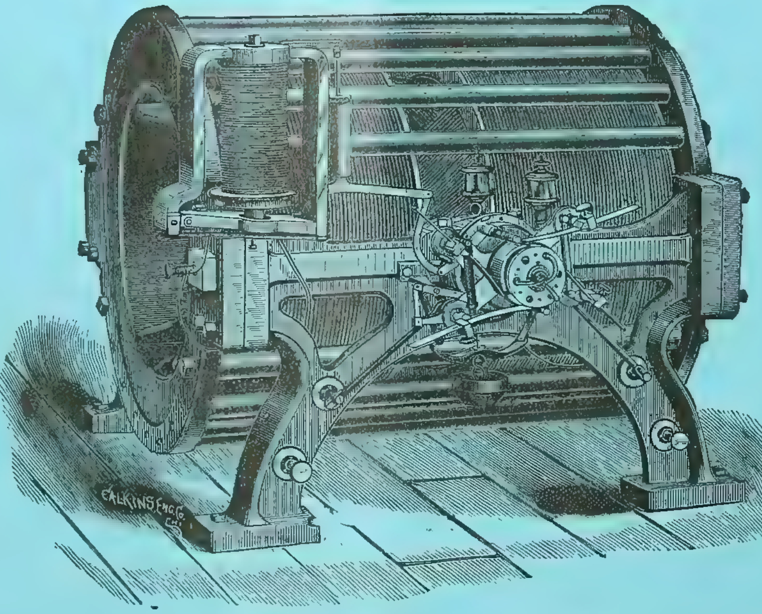

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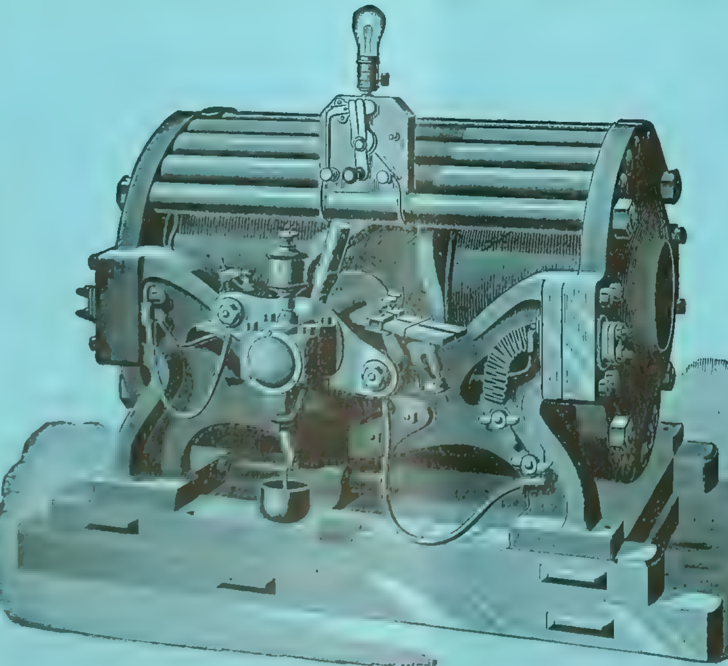

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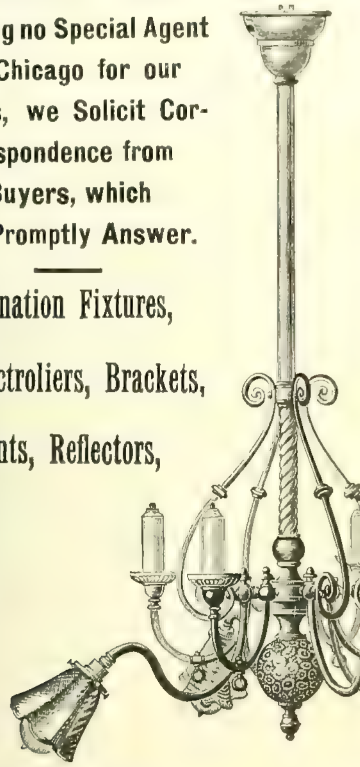

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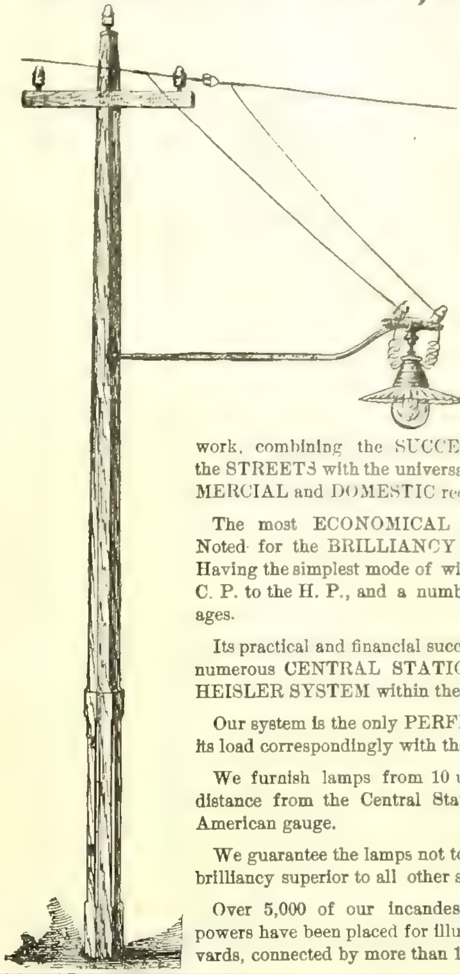

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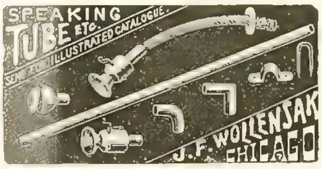

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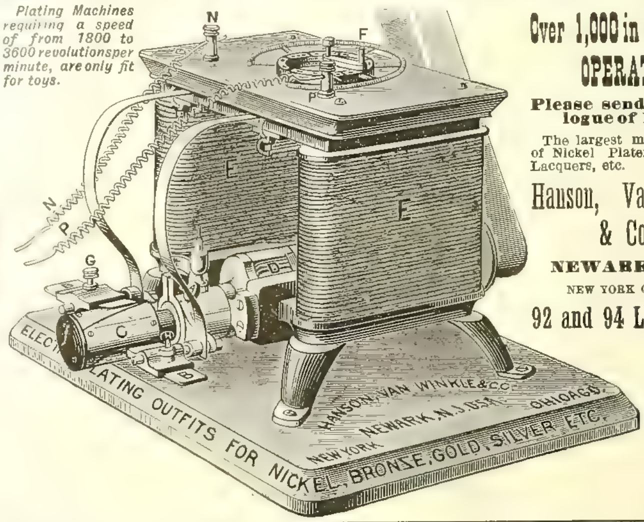

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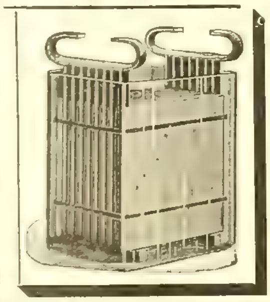

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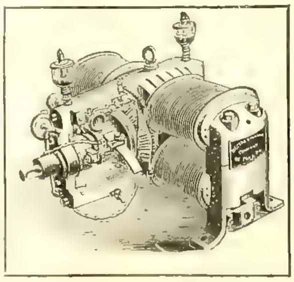

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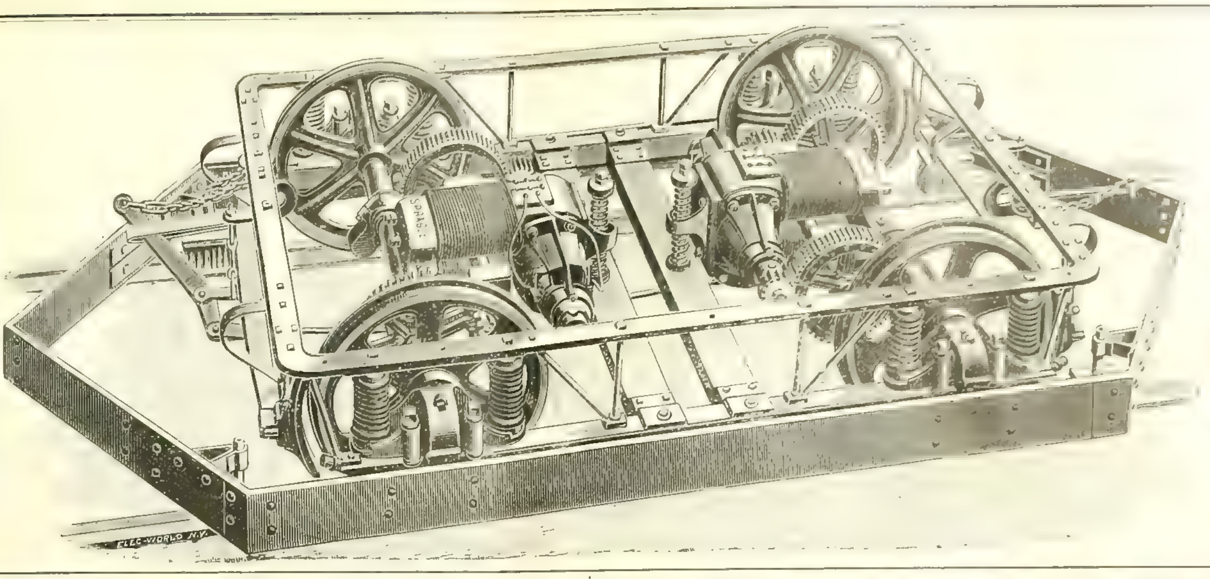

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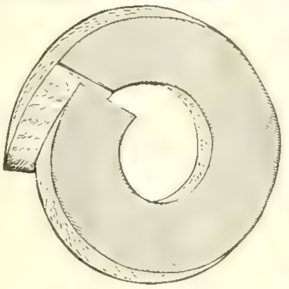

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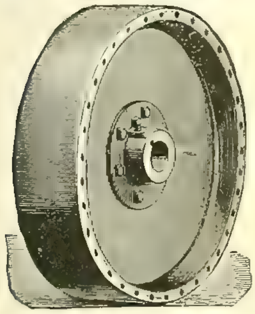

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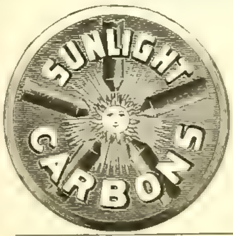

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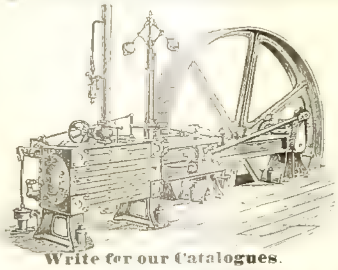

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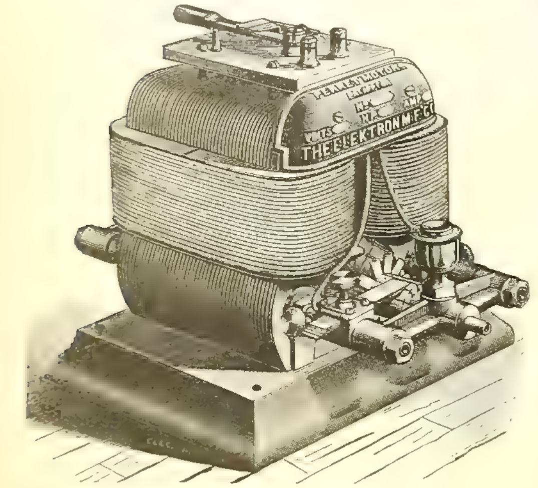

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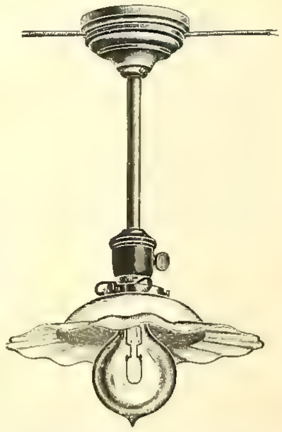

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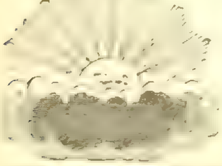

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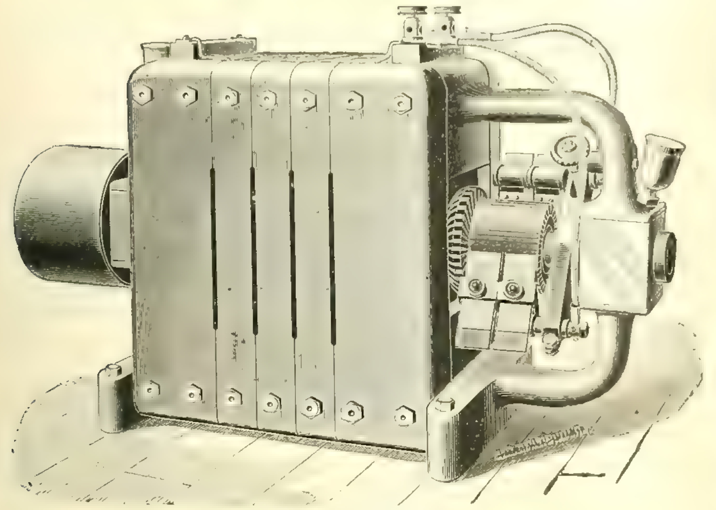

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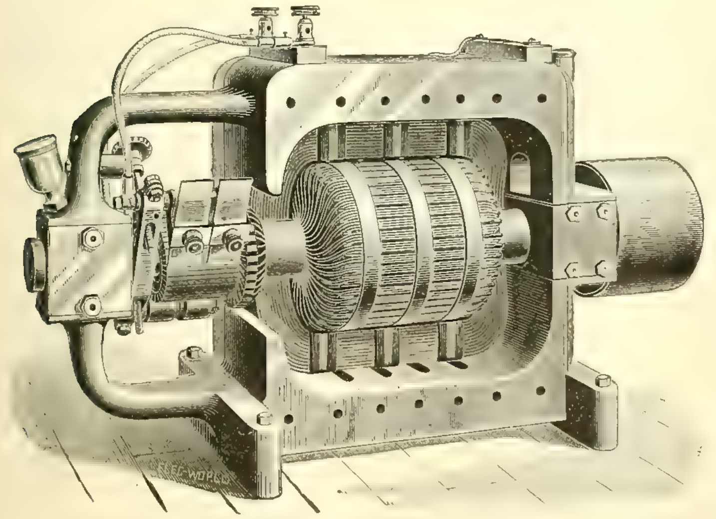

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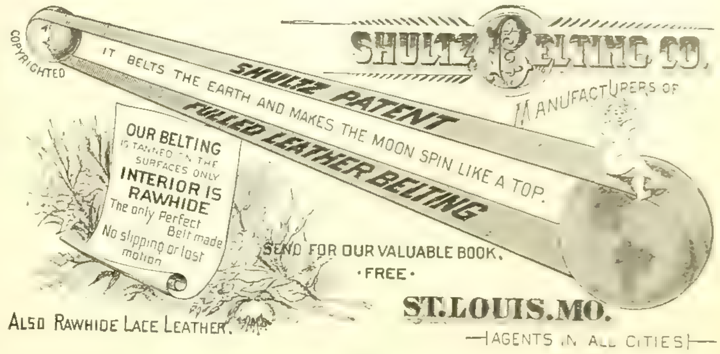

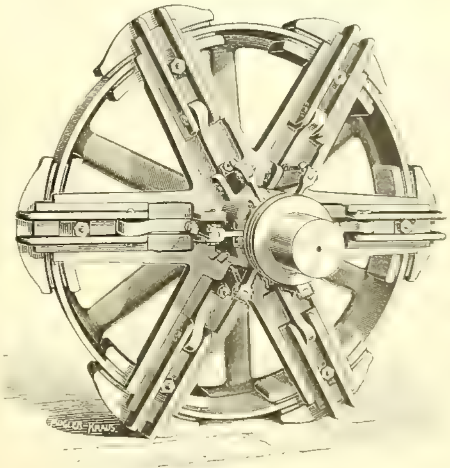

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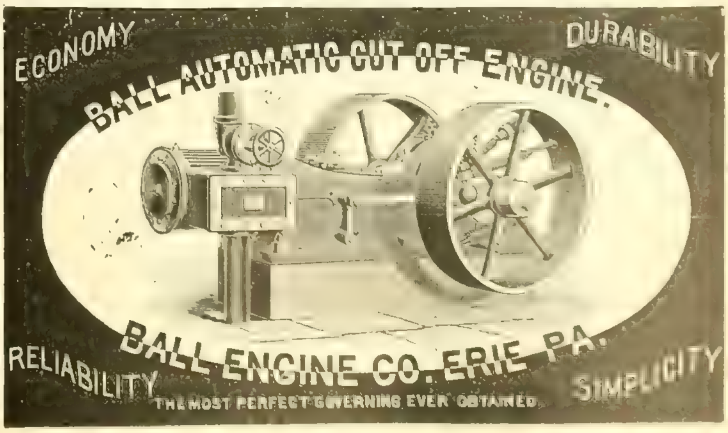

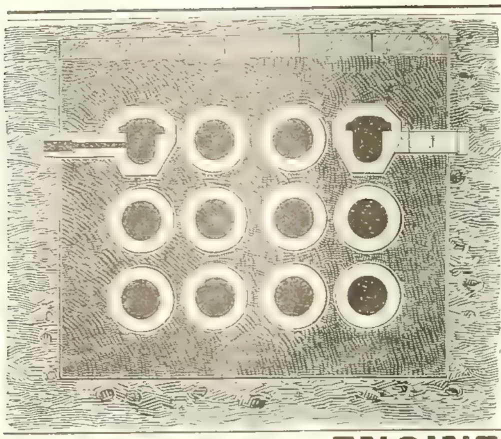

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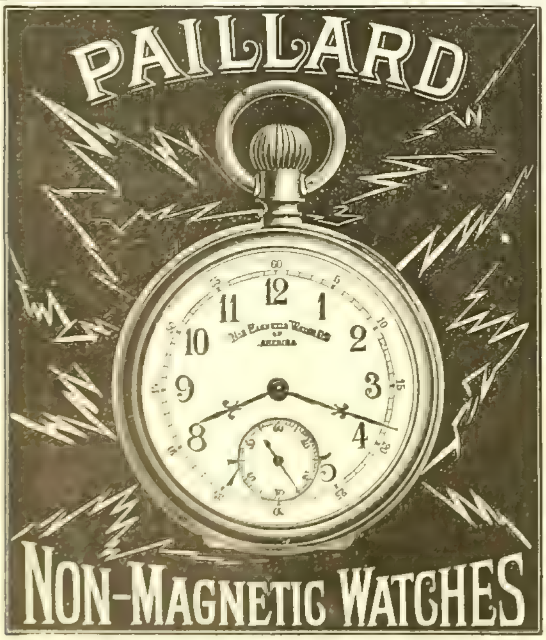

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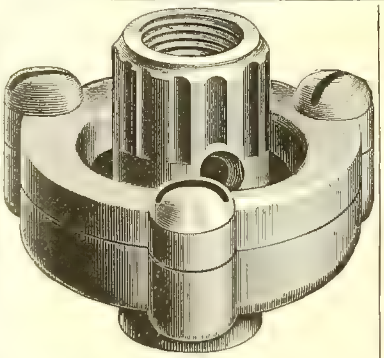

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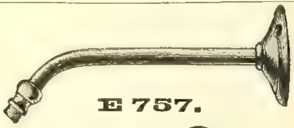

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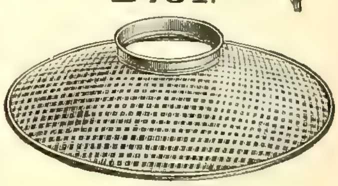

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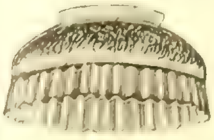

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Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor ?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

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Vol. IV. | CHICAGO, APRIL 20, 1889. | No. 16

Prof. Elisha Gray.

A portrait of Prof. Elisha Gray is herewith presented. The cut is reproduced from a recent photograph, and the likeness is admirable. Prof. Gray was born at Barnesville, O., August 2, 1835. When a lad he was apprenticed first to a blacksmith, and subsequently to a carpenter and boat-builder. He learned all of these trades, and upon the completion of his several apprenticeships he entered Oberlin College, and made a special study of physical science, supporting himself meanwhile by working at his trade. In 1867 he obtained his first patent for telegraphic apparatus—a self-adjusting relay. Since that time he has taken out nearly fifty patents, the most important of which relate to his printing-telegraph system, that was largely in use before the advent of the telephone, the harmonic telegraph, the telephone and the telautograph.

All of Professor Gray's inventions bear the stamp of thorough originality, and in no sense can he be called an adapter of ideas furnished by others. He was the first to transmit several messages simultaneously over a wire on the harmonic plan, and his famous caveat of February 14, 1876, contains the first written description of the speaking telephone. The first speech transmitted over a wire was with instruments similar to those described in that caveat, and so perfect is that description of the form of the telephonic current that nothing important has been added to it to this day.

The professor has been occupying himself for some years past with his telautograph or writing telegraph, and in this wonderful invention he again displays the most remarkable genius and individuality. He has his laboratory at Highland Park, Ill., where he resides. He is a member of the faculty of Oberlin College, and in 1878 was honored at the Paris Exposition with the red ribbon of the Legion d' Honneur.

PROF. ELISHA GRAY.

Manhole Explosions.

T. W. Langill of New York has suggested to the Board of Electrical Control of that city a scheme for ventilating underground conduits, by which he hopes to prevent gas explosions in the subways. The plan is thus described: An air chamber is constructed beneath the covering of the manhole. A tube leads from this chamber to the lower part of the manhole, where the heavy gases settle, and another tube leads directly from the manhole under the pavement to a vent in the gutter. The temperature of the plate covering the manhole, it is claimed, varies at all seasons of the year from the temperature of the gases in the bottom of the manhole. In summer the air in the chamber becomes hot, and, as it expands, forces the heavy gases out of the manhole, and in winter the cold air sinks to the bottom, and thus forces out the gases. This keeps up a constant circulation, and, Mr. Langill thinks, will prevent the danger of explosions.

City Electrician Barrett of Chicago, who has made a study of the question of ventilating conduits, says the proposed scheme will not serve the purpose. "I tried that right out here," he said to a representative of the WESTERN ELECTRICIAN, pointing out of the window of his office in the city hall; "it didn't work. It may help a little in the summer, but it cannot be depended on for permanent relief."

In connection with the subject of gas explosions in conduits, it is said that the Chicago Arc Light & Power company has had several burn-outs in manholes, and no explosions have resulted. This is explained by the fact that the wires were raised in the manholes, and the gas was lodged in the bottom. Advocates of the theory of spontaneous combustion cite this fact in support of their views, and also point to the fact that in many cases, where examinations of the conduits and wires were made after an explosion, no cause could be discovered—the wires were all right, and the only explanation was spontaneous combustion. The burn-outs in the manholes are thus explained: When men are working in the conduits they often jump on the cables, and stand on them, and frequently they crack the insulation. This accomplished, the rest naturally follows.

Eckhardt-Baker Telephone Bill.

A Springfield, Ill., dispatch, dated April 11th, says: Another attempt was made in the house this afternoon to take up the senate telephone bill out of its regular order. Several of the younger members had put their heads together and concluded that the bill should be agitated, and it was Mr. O'Toole of Lake who made the motion to suspend the rules. But Mr. Merritt at once denounced the movement, and said that it was freighted with suspicion, and a roll call being demanded, the house refused to suspend the rules by a vote of 66 to 43.

Electrolytic Treatment of Sewage.

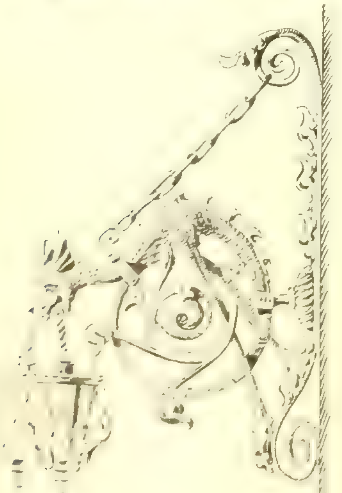
[illegible] growing importance in every great city, and [illegible] of the problem. One can scarcely glance over a paper in any large city without finding s[illegible] complaint of the existing method of sewage disposal. In the WESTERN ELECTRICIAN of February 18, 1888, it was stated that William Webster of London had devised a process for the electrolytic treatment of the waste of cities. Mr. Webster is a contractor who has had an extensive experience in dealing with the drainage problems of the English metropolis. In the latter part of March representatives of the press were invited to inspect the experimental works which have just been completed at Crossness. The plant was built by Mr. Webster to demonstrate the feasibility of his plan. From the London *Electrician* and *Electrical Engineer* the following descriptive matter and accompanying cuts are taken:

The chemical method is at work in several towns in England, but is unsatisfactory for several reasons: one is the great expense for chemicals; another is the actual labor in mixing; moreover, the precipitation accomplished, the effluent has still to be oxidized or purified, and the addition of chemicals to the water still tends to a prejudicial effect by reason of its alkalinity. These defects are entirely overcome by the electrical system of treatment. The cost, as far as can be judged, is much less. The expense of chemical treatment is not accurately known, but varies in different towns from 30 to 70 shillings per 1,000,000 gallons, whereas Mr. Webster calculates that the electrical system will cost only 13 shillings per 1,000,000 gallons for the actual cost of working, not including interest and depreciation, or including this, which will vary according to the make of engine and machinery, say, not over 20 shillings per 1,000,000 gallons. Mr. Webster, therefore, calculates that for the actual cost of working, the amount for purifying the total London sewage will be about £36,000 a year. When it is remarked that the authorities have been considering the expenditure of over £100,000 a year for this purpose by chemical means, the saving of the electrical process can be seen at once. Even calling it [illegible] £60,000 a year, this would be one-half the expenditure proposed, and even [illegible] better effect would be produced by the electrical process.

Mr. Webster conceived the idea that the precipitation might be brought about by [illegible] and made some experiments to carry out this process with carbon plates; but it was [illegible] about three years ago that the idea of using [illegible] plates as electrodes, which has made the process a success, occurred to him.

On Wednesday, Mr. Webster showed some experiments with test glasses of [illegible] by electrolysis, with [illegible] the action which takes place in this system. Several tall glasses were filled with sewage of varying strength, taken from the [illegible] the day before. Wires were led [illegible] to a pair of electrodes, which [illegible]

[illegible] frame; and when this simple arrangement was placed in the vessel and twisted about ebullition at once commenced, the matter in suspension became flocculent and rose in a scum to the top. In a few minutes the absolutely black and opaque liquid became variegated, the particles became detached, and shortly the liquid became more or less clear, with the solid matter separated. The scum and solid matter rises at first with the ebullition of hydrogen to the top, but afterwards subsides, and the effluent can be run off. The reaction is supposed to be as follows: At the positive pole nascent chloride and oxygen are given off, forming hypochlorite of iron. This hypochlorite of iron is precipitated by the ammonia, soda, etc., at the negative pole, and forms hydrated ferrous oxide. This particular oxide has the property of combining with organic matter, and flocculent particles are formed, which carry away the whole of the matter in suspension. The organic matter in solution is oxidized, and with proper care the water may be drawn off perfectly pure and bright. That the matter in solution is precipitated, was shown by the action of the same current upon a tube of water tinted with an aniline dye, the color of which was rapidly [illegible] by the action. The effluent [illegible]



[illegible] ing quality [illegible] taking [illegible] rapidly [illegible]

At first the method adopted was similar to that of the test tubes on a much larger scale. Huge tanks [illegible] plates of iron were connected and placed in these tanks; the whole quantity of sewage was heated and then drawn off to settle while [illegible] was run into the tanks. It was found, however, that a continual motion of the electrodes was required to get sufficient contact with the liquid, and it was decided to abandon the tank system and adopt the method of having the [illegible] in motion instead of the plates.

The system now at work at Crossness consists, in effect, of a long shoot doubled twice upon itself, down which the sewage gently flows after having been pumped up by the pump at one end, shown in Fig. 1. All along this shoot are placed the electrodes in groups of fifteen plates each. The arrangement of the plates on the shoot is shown in Fig. 2, the plates lying along the direction of the current. There are 22 sets of 15 plates each in parallel, and six such sets in series. The electrical pressure across the electrodes is 2.8 volts; the total pressure is therefore six times this, and allowing a certain loss in the leads, makes the pressure at the dynamo to be 20 volts. The manner of connection between the sets in series is illustrated by the diagram, Fig. 3. The shoot is of wood, but in any permanent work it would be of brick, concrete, or iron, and the bottom would be lined with asphalt or other suitable material. The plates at present are of wrought iron, but for ordinary work would be cast out of ordinary pig iron.

The sewage as it comes in flows along the upper shoot and back again twice, all the while passing between the electrodes; every particle comes in contact with the plates and becomes electrolyzed. By the time it has got to the outfall, a few minutes only, it is sufficiently treated; it is run into one or other of the settling tanks and allowed to settle for an hour, perhaps two, and the effluent is then run off into the river. Such is Mr. Webster's system of electrical treatment of sewage, a simple and eminently scientific method, which cannot fail to entirely revolutionize the systems of town disposal of sewage.

The dynamo used is an Edison-Hopkinson, working at a pressure of [illegible] volts, and capable of developing an energy of 43-horse power. The whole of the current is not at present utilized, about [illegible] amperes being the quantity now employed. The [illegible] driven, by means of counter-shafting, by an engine of old type, made some [illegible] years ago, of [illegible] horse power.

The speed of the dynamo is regulated by a Rung's pneumatic speed indicator, connected [illegible] the dynamo, but placed beside the engine [illegible] the strength of cur[illegible] of sewage is very [illegible] to keep the volt[illegible] electrodes. If the [illegible] immediately goes up to [illegible] resistance, and the speed of the dynamo is then lowered to give the usual pressure.

The experiments at Crossness have proved that with 27-horse power it is possible to treat 1,000,000 gallons of sewage in 24 hours. These figures relate to London sewage, where the rainfall is mixed with the sewage. For towns where the rainfall is distinct, less power would be required, for the stronger the sewage in chlorides, etc., the less the electrical resistance.

As to the cost of the engine power, we need hardly state that the newest type of engines suitable for driving dynamos may be taken to consume two pounds of coal per horse-power-hour. and according to the price of the coal will be the working cost. The experiments carried out with reference to the amount of iron consumed by this process tend to prove that the consumption in continuous working should not be more than two grains per gallon. Here, again, the cost entirely depends upon the district in which the works are situated, with regard to the price of pig iron. The plates are one inch thick, and if used in sufficient numbers would last for many years when once fixed. For instance, a town with a flow of 10,000,000 gallons of sewage per day, corresponding to a population of 333,000 at 30 gallons per head, will require to treat this amount of sewage a consumption of iron not exceeding 464 tons per annum. On calculating the amount of mechanical power required per head of the population, Mr. Webster finds it represents [illegible] of a horse power, or 8 horse power per 10,000.

It will be seen that the above plant is practically in lieu of the mixing-tanks, machinery and chemicals employed in chemical processes for the treatment of sewage, and if such electrical plant is designed to meet the peculiar requirements of any particular district it should cost much less and have a greater efficiency than any other process known, for not only does this electrical method precipitate the matter in suspension, but it also removes organic matter in solution, and forms a precipitating and disinfecting process in one operation.

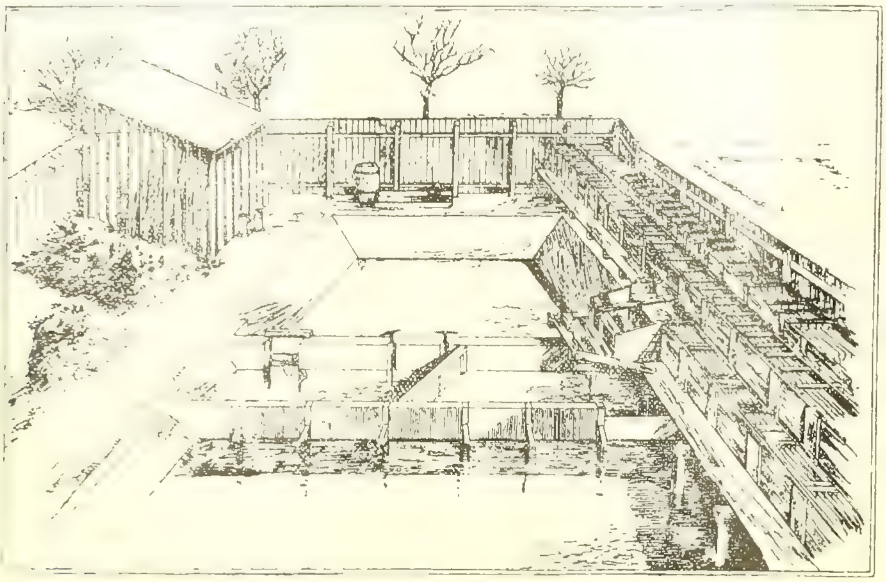


FIG. 1. ELECTROLYTIC TREATMENT OF SEWAGE.

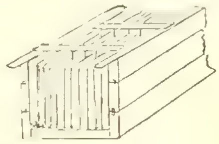


FIG. 2.

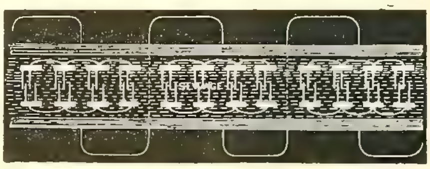
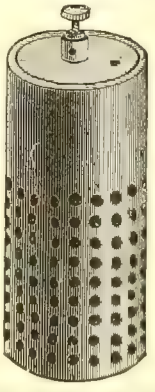


FIG. 3.



NATIONAL GALVANIC CELL.

The present works—where the system is shown in operation at the rate of 12,000 gallons per hour—have cost Mr. Webster some £5,000 to erect and carry on.

The average of 20 analyses taken at Crossness during 1888-9 show that of raw sewage, very turbid and opalescent, containing 33.35 parts of suspended matter in 100,000, the effluent was clear, containing 1.56 parts per 100,000.

New Electrolier.

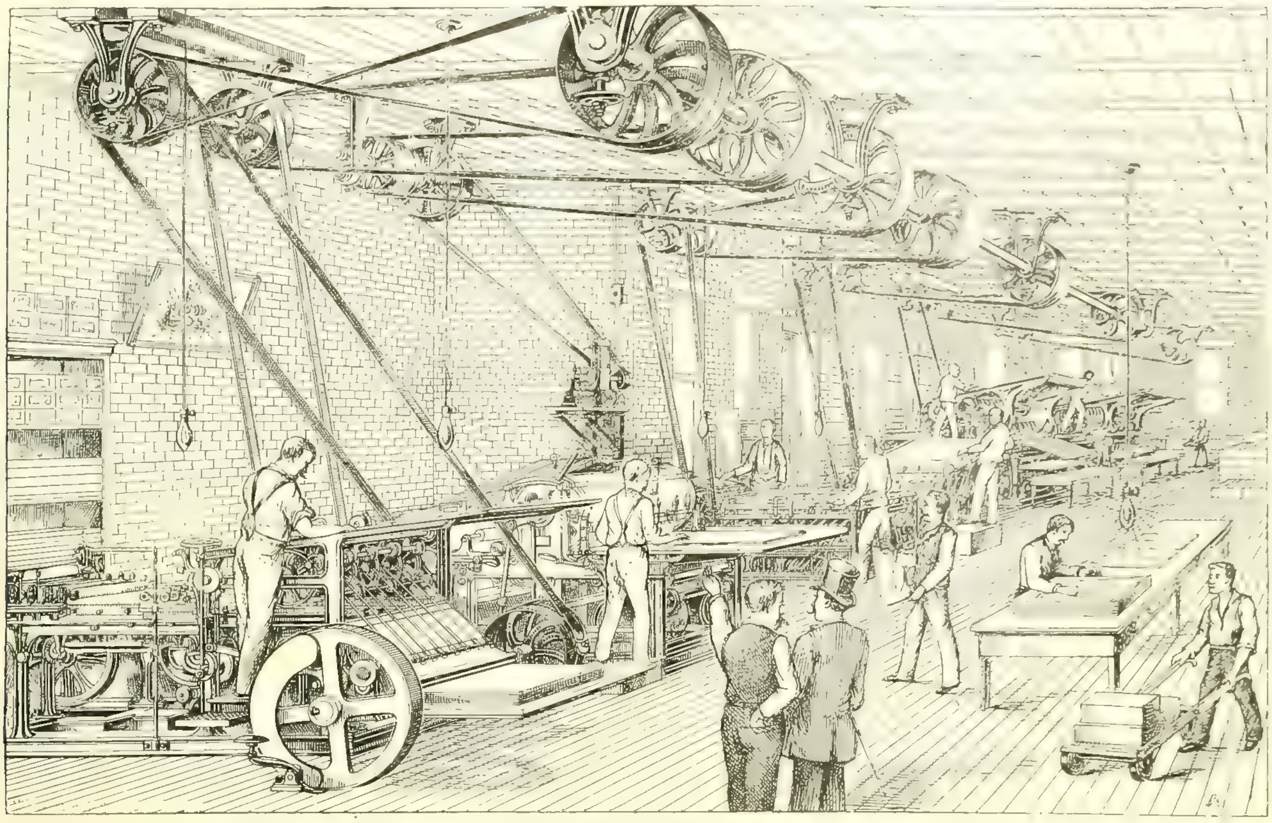
Incandescent lights possess many points of superiority over gas, and not the least important consists in the fact that the lamps can be employed for ornamental purposes with striking effect. The utilization of incandescent lights for decorating purposes has opened a field in which much excellent work has been done. Among the latest electroliers of artistic design are several put on the market by the Horn, Brannen & Forsythe Manufacturing company of Philadelphia. One of the number is illustrated in the accompanying cut.

National Galvanic Cell.

The perforated cup of the National battery is shown in the accompanying cut. It is claimed to be one of the most efficient open circuit batteries. Tests have demonstrated that it does not polarize rapidly, and that it recovers rapidly. The battery is made by the National Galvanic company, New York.

Davis Motor in a Press Room.

The employment of electric motors in printing establishments is constantly growing. The motors are so admirably adapted for the work that printers are beginning to wake up to the advantages which attend their use. Journals devoted to the printing trade have in many instances taken up the question, and a number of interesting articles on the subject have already appeared. In speaking of the use of motors in printing establishments, a gentleman said a few days ago: "This is to be a great field for the motor men. The attention of printers has not been directed to the matter particularly. I only wish they could have a chance to read the electrical papers." The accompanying cut gives a view of the establishment of Razall & Co., printers in Cincinnati. An 8-horse power Davis motor, manufactured by the Queen City Electric company of Cincinnati, furnishes power. The installation has given great satisfaction, and it has been inspected with interest by a great many printers.



DAVIS MOTOR IN A PRESS ROOM.

Lamp Cut-Out for Motor Circuits.

Many of the arc electric light companies throughout the country, while perhaps not yet engaged in the electric power business, are, nevertheless, watching with considerable interest the progress and development of the constant current systems of power distribution. The fact that motors can be successfully run on circuits with arc lamps has been fully demonstrated, and companies running day circuits find in the much-maligned arc motor a source of revenue not to be neglected. Those, however, operating arc light plants in places where the demand for day lights is not sufficient to warrant investment in a day circuit, are in many cases, from the necessarily gradual growth of the business and the fact of their having to lay another circuit for motors alone, unwilling to make the venture. The device illustrated in the accompanying cuts was designed with a view of making existing circuits for night lamps available during the day for motor circuits.

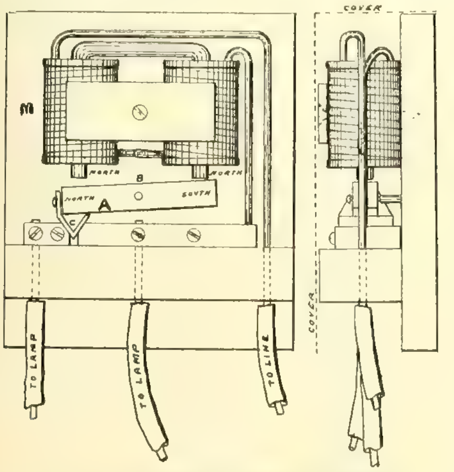


FIG. 1. LAMP CUT-OUT FOR MOTOR CIRCUITS.

It consists, Fig. 1, of an electro-magnet, *M*, so wound that the passage of the current, no matter what its direction may be, will always produce *like* poles at the extremities of the magnet (*i. e.*, north and north or south and south). This electro-magnet, *M*, is connected directly in the main circuit, as shown in Fig. 2. Beneath this magnet *M*, and pivoted at *B*, as shown, is a [illegible]

[illegible] direction of rotation of the armature of a series wound constant current motor is not affected by a change in the direction of current, and also that like poles of magnets repel and unlike poles

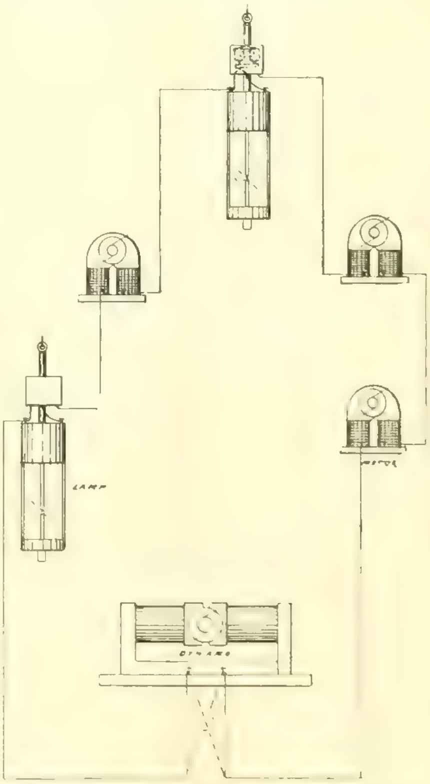


FIG. 2. LAMP CUT-OUT FOR MOTOR CIRCUITS.

attract each other, the operation of the [illegible] and its application may be readily [illegible].

Where every lamp [illegible] has been fitted with one of these cut-out switches, the [illegible] tender can keep the motors running and [illegible] the lamps [illegible] just as he wishes. [illegible]

simply sending the current through the line in [illegible] ...ctro-magnet of [illegible] ...y in the main [illegible] ...t so long as it is on the line, its action on the polarized arma-[illegible] ...tance. Many [illegible] ...here a polarized [illegible] with an electro-[illegible] ...less it subjected to the action of the current for any length of time. In this device permanency is secured by the peculiar winding of the electro-magnet and

FIG. 2

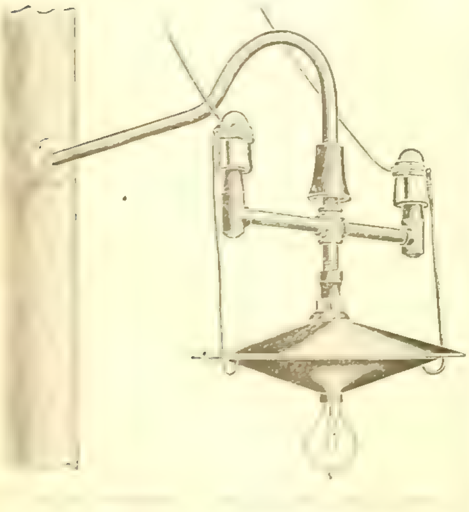
FIG. 3.

its arrangement, as shown, relative to the permanent bar magnet.

The device is the invention of Frank L. Perry, electrician of the Baxter Motor company of Chi-[illegible]. It has been practically tested on arc cir-[illegible], and has worked satisfactorily.

Bernstein Series Incandescent System.

Among the forms of incandescent lighting which have attracted more than usual attention during the past few months is the system of connecting the lamps in series, and the number of lamps used in that manner is now very large, and is constantly increasing. The accompanying cuts illustrate the series system of the Bernstein [illegible] tric company of Boston. The company [illegible] rded the use of electro-magnetic mechanism [illegible] roviding a path for the current around the [illegible] ed lamp, and now relies solely on a very [illegible] levice which is contained in the lamp



[illegible]

out the entire current must pass through the shunt, the resistance of which immediately falls, by the action of the heat upon the compound, to practically nothing; and the compound being softened by the heat, the metal pieces are brought into direct contact with each other by the action of a powerful spring, so that, actually, double provision is made against opening the circuit.

The lamp socket is so constructed as to provide against opening the circuit through failure of the lamp or by [illegible]. An important

FIG. 6.

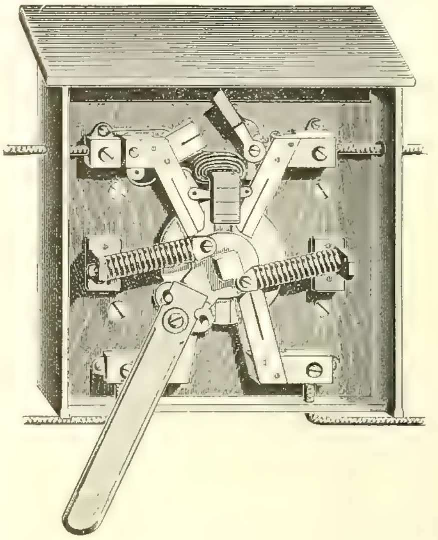


FIG. 7.

BERNSTEIN SERIES INCANDESCENT SYSTEM.

feature of the socket is the use of insulating material for all the outside parts for the purpose of securing absolute protection from shocks. Figs. 2 and 3 show the complete socket ready for the lamps and the socket with insulating cap removed.

Experience having shown that special switches were required in using incandescent lamps in

FIG. 4

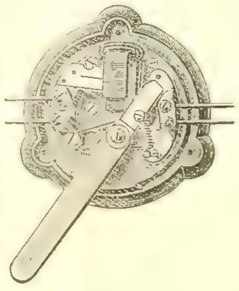


FIG 5

BERNSTEIN SERIES INCANDESCENT SYSTEM

series, the switches shown in the cuts were designed. They are constructed for the purpose of destroying the arc which must form between the switch terminals whenever several incandescent lamps are thrown into the circuit by a single switch. They are at present made in two forms—the simple "shunt" switch, Figs. 4 and 5, for a few lamps, and the "cut-off," Figs. 6 and 7, for use on the outside of buildings, for entirely disconnecting the main line from the branch. The peculiar feature of the switch is the introduction of an electro-magnet, which is so placed that its coil is always in the main circuit and the opening between the switch terminals in its magnetic field. Upon the formation [illegible], when the switch is opened, the lines [illegible] and so prevent the [illegible] follow any con-[illegible]. The company has recently [illegible] for using its series [illegible] idescent lamps for street lighting. Figs. 8 [illegible] 9 [illegible], and also with the [illegible] the "con-[illegible]

[illegible] increased [illegible] just moved [illegible] it has equipped [illegible] adapted to [illegible] switches and [illegible]

Complimentary Dinner in Honor of F. Sargent

It was a jolly party of Edison men that gathered in the "gold and silver room" at Kinsley's April 11th, and sat down to partake of a complimentary dinner in honor of F. Sargent, the general superintendent of the Chicago Edison company, who is about to leave the city to accept the position of chief mechanical engineer and superintendent of construction with the Edison United Manufacturing company in New York. When the gentlemen had done justice to the good things provided by mine host Kinsley, and cigars had been lighted, Toastmaster L. A. Ferguson introduced the following gentlemen, who responded in a happy manner: J. H. Goehst, W. G. Whitmore, John Meadon, W. L. Church, J. F. Gilchrist, J. R. Dishington.

Mr. Sargent was then called upon. He gave a glowing prophecy of the "future of the Edison business." After the postprandial exercises, the toastmaster, Mr. Ferguson, with appropriate remarks, presented Mr. Sargent a very handsome umbrella as a souvenir from his Chicago Edison friends. During the evening interesting violin selections were rendered by E. C. Freeze, with piano accompaniment by H. E. Niesz. F. N. Armour, C. S. Kaufman, D. W. Fuller and H. A. Githens added to the evening's entertainment by interesting stories.

That Mr. Sargent was a favorite with the electrical and mechanical staff of the company

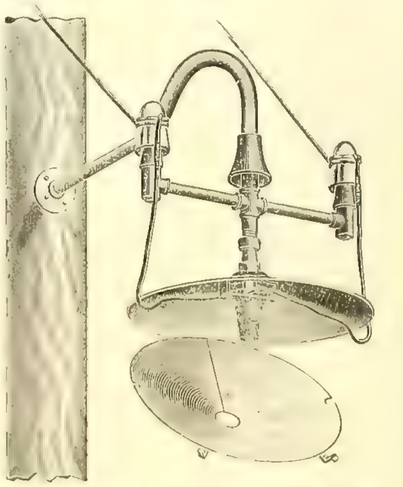


FIG. 9. BERNSTEIN SERIES INCANDESCENT SYSTEM.

was evident. He has proven himself a friend to those with whom he was associated in business, and bears with him their best wishes.

Last Thursday Mr. Sargent was again entertained by a company of his friends at Kinsley's. After a dinner he was presented a silver tea and coffee set. The salver bore the inscription "Frederick Sargent, from a few friends, Chicago, 1889." Among those who were present were J. L. Barclay, John H. Shay, W. B. Pearson, C. M. Barclay and Mr. Gibson.

Storage Batteries for Street Cars.

"Edco," the new storage battery street car of the Electro-Dynamic company of Philadelphia, made a very successful trip last week over the Darby branch of the Traction line. This particular road was selected for a trial trip owing to the long, steep grades and sharp curves with which it abounds.

When the car noiselessly glided out of the depot at Forty-ninth street and Darby road it contained a dozen persons, among whom were E. A. Scott, superintendent of the Electro-Dynamic company, several railway men and representatives of the press. The car started off at a speed of about six miles an hour, and not the slightest decrease of speed was noticeable in ascending the steep grade just beyond the depot, and when on the level the car easily ran at ten or twelve miles an hour. It was started and stopped with the greatest ease.

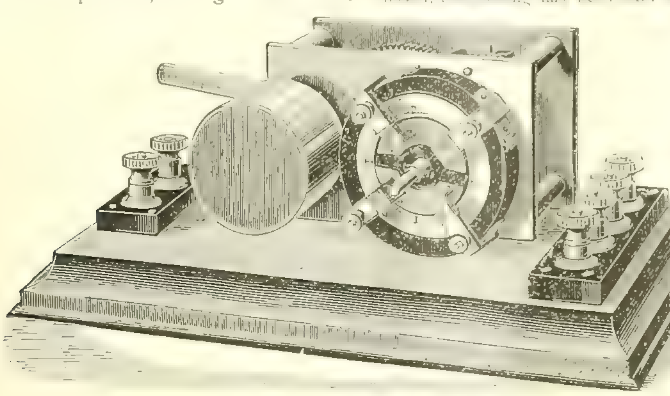
On a particularly bad piece of track, a sharp curve on a hillside, the car left the track, but by the application of a little more power from the batteries the motors backed the car into place on the rails, and the trip was resumed with but little delay, and without blocking the road.

The experimental car is a trifle heavier than that of the ordinary street car. The two electric motors, with the necessary gearing, weigh about a ton. The battery consists of eighty-eight hard rubber cells, and is arranged under the seats of the car. It weighs one and a half tons. This supplies the current for two electric motors, each geared to a separate axle of the car. The motors are made to give 1,000 revolutions a minute, with the full power of the battery, but by the use of gear wheels this is reduced so as to run the car at the ordinary speed of eight to ten miles an hour. Each of the motors will give 13-horse power when the full force of the battery is applied, and this is ample for any work which they may be called upon to do. The company claim that sufficient energy is contained in the eighty-eight cells to run the cars sixty miles, under ordinary conditions. The batteries used are manufactured by the Electrical Accumulator company of New York, which has been making extensive experiments in this line.

The conduit of the National Conduit company, of New York, has been adopted by the New England for all its permanent work. Next month conduits will be built in School and Milk streets, Boston.

Ayrton and Perry's Secohmmeter and Secohm Standard.

[illegible] Perry [illegible] the market [illegible] meter [illegible] of [illegible] it [illegible] with the [illegible] and [illegible] The standard secohm [illegible] standard resistance [illegible] the Wheatstone bridge, in fact, the [illegible] a very [illegible] descriptions of the [illegible] lished, [illegible] has been said [illegible]



AYRTON & PERRY SECOHMMETER.

instrument. From James W. Queen & Co., agents for Ayrton & Perry instruments, the appended description, explanatory of the mode of using the secohmmeter for determining absolutely or comparing the coefficients of self induction, has been received. The instrument, as well known from former descriptions, consists of two rotary commutators, each with four stationary brushes. The commutators are on the same spindle, one at the front and the other at the back of the secohmmeter, but for convenience they are shown in the accompanying symbolic figures as if they were in the same horizontal plane; in reality, however, the brushes, b_1, b_2, b_3, b_4, are at the top of the instrument. One commutator, *G C*, is for periodically reversing the galvanometer connections, and the other, *B C*, for reversing the battery connections. An adjustment is provided for enabling the relative positions of the two commutators to be varied, so that both reversals can be made to occur simultaneously, or one a little before or after the other, or one reversal midway between two successive reversals of the other.

The commutators can be driven at one or other of two speeds relatively to that of the driving handle, *H*. With one arrangement there are rather more than eight reversals of both the galvanometer and of the battery for one revolution of the handle, and with the other twenty-four reversals of each for one revolution of the handle. The secohmmeter can be conveniently driven by hand so as to obtain a steady speed of 300 to 6,000 reversals per minute of both the galvanometer and the battery.

To shift from one speed ratio to the other, press down the end of the locking lever at the right of the secohmmeter, and slightly push in or pull out the handle, turning it slightly to assist the toothed wheels engaging properly; when engaged, let go the end of the locking lever.

1. *To* [illegible] *Coefficient of Self-induction.*—Join up the apparatus as shown in Fig 1,[1]; if the resistances, r_1 and r_2, of the non-inductive branches of the bridge be adjusted to give balance with a steady current, balance will also be obtained on rotating the secohmmeter, when

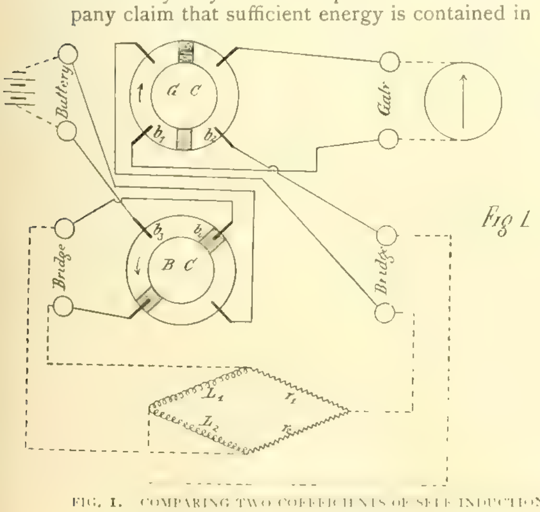


FIG. 1. COMPARING TWO COEFFICIENTS OF SELF-INDUCTION.

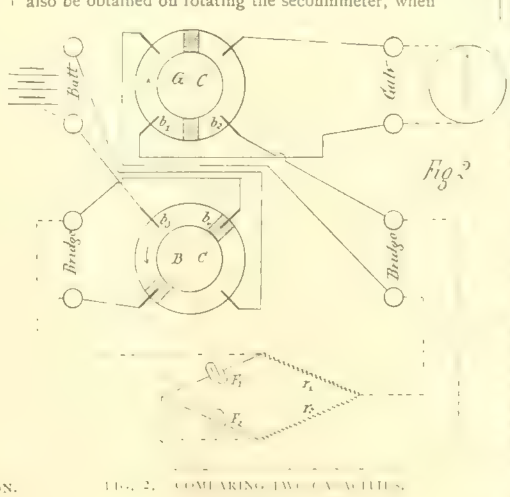


FIG. 2. COMPARING TWO CAPACITIES.

$$L_1 \ldots$$

L_1, L_2, being the coefficients of self-induction of the [illegible] ductive branches. The speed at which the secohmmeter is driven need not be known, but the greater the speed the more sensitive the test; the rate of reversal must not, however, be too great for the currents to reach their steady values between two consecutive reversals.

2. [illegible] Join up the apparatus

[1] The continuous lines represent the permanent connections [illegible] secohmmeter [illegible] the dotted lines, connections temporarily made outside the instrument.

[illegible] meter, when [illegible]

or they may be as in Fig. 3, in which case the reversal of the galvanometer just precedes the reversal of the battery. [illegible]

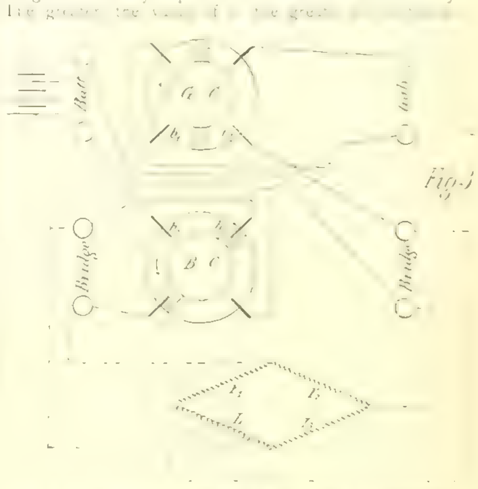


FIG. 3. [illegible]

flection, d_1, and the more accurately can it be read, but the speed must not be too great to prevent the currents reaching their steady values between two consecutive reversals of the battery. Whether this condition be fulfilled or not can be best ascertained by seeing whether the same value is obtained for L, for a speed considerably smaller than [illegible] Instead [illegible] ing two deflections, the resistances, [illegible] are first adjusted to give balance with a steady current, and then one of them, say [illegible], is altered by an amount [illegible] so that there is still no deflection of the galvanometer when the commutator spindle makes, say [illegible] revolutions per second, then

$$L = \ldots \text{ secohms, approximately}$$

where [illegible] is a constant depending on the relative positions of the commutators. The value of the constant [illegible] is most accurately ascertained once for all, for a given relative position of the commutators, by experimentally de-

termining the value of [illegible], that produces [illegible]

known coefficient of self-induction, when the commutator spindle is driven at some unknown number of revolutions per second.

For this test, [illegible] it is necessary that the commutators be so placed relatively to one another that the galvanometer is not reversed exactly midway between two successive reversals of the battery, since [illegible] no variation in the resistance of [illegible] bridge can counterbalance th[illegible] on rotating the secohmmeter [illegible] nearly the commutators are placed [illegible] ment, the smaller will be the value [illegible]

the larger the value of [illegible] to produce balance [illegible]

values of [illegible] and [illegible]

[illegible] the [illegible] having set [illegible] the galvanometer is reversed [illegible] using the higher speed [illegible] the [illegible]

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DEPARTMENTS.

[illegible]

THE marvelous activity which exists in the electrical world is shown by the fact that on April 9th fifty-three patents relating to electrical inventions were granted. The list which appears elsewhere is well worth a study.

AN excellent portrait of Prof. Elisha Gray, reproduced from a recent photograph, accompanied by a brief biographical sketch, appears [illegible] the present time, when the [illegible] telautographic system is to be put into practical operation, the article will be read with especial inter[illegible]

[illegible] motor installations are [illegible] Trowbridge [illegible] The [illegible] attracting con[illegible] The method could be utilized to good advantage in [illegible]

[illegible] organization. [illegible]

[illegible] meeting [illegible]

would be served from Kinsley's restaurant. The work of adapting the rooms to the necessities of the club will now be taken up, and will proceed rapidly. This news will be interesting, we think, to a large number of the electrical fraternity, besides those who are members of the club.

THE decision of Judge Brown in the United States Circuit court at Detroit, on the question whether an inventor [illegible] for a patent can maintain a bill for [illegible] before the issue of a patent, is one of much interest and importance. A resume of the decision is given in the Detroit letter. Under the law, as it is at present, the courts have no jurisdiction in such a case, according to Judge Brown, so that the inventor must look elsewhere than to the patent law for any protection he desires in advance of the actual issue of a patent. The practical difficulties, which Judge Brown points out, in the way of a court assuming jurisdiction are so great that it is thought it is not likely congress will seek to confer it.

A GREAT many street car managers throughout the country have been watching with interest the trial of the several electric systems by the West End company of Boston. For over three months the road has been equipped with electric motors. It is a satisfaction to read in a Boston paper in an article which reviews the brief history of the new system, that "the result, as a whole, has more than met the most sanguine expectations of President Whitney." * * * "The electric cars are undoubtedly popular. It is seldom that both the electric and towed cars are not well filled, and many people allow the regular horse cars to pass by for the sake of riding in an electric car. The heavy grade on Cambridge street, Boston, is easily surmounted by the electric train at a rate of six or seven miles an hour, and it is a pleasure for passengers to reflect that in ascending the hill horses are not straining themselves to haul up a car with from 25 to 80 or 90 passengers. One good thing about these cars is the fact that teamsters are rather shy of them, and are more prompt to get out of the way, and not so apt to drive directly across the track in front of them, as is the case when horses are in advance of the car."

J. W. Gwynn read an interesting paper at Mansfield, O., before the recent convention of the Ohio gas companies. His subject was "Oil as a Fuel under Boilers," and he treated it in a practical manner. He had made numerous experiments to determine the relative merits of crude oil and coal as fuel. Each was used thirty-one consecutive nights, with conditions as nearly similar as possible. The consumption of coal was sixty-five and one-half tons in the thirty-one nights, and of oil 251 barrels during the thirty-one nights following, showing that a little less than four barrels of oil had performed the work of a ton of coal. He found a saving of $36.52 in favor of oil, and says: "A safe rule is, wherever and whenever four barrels of oil can be bought for less money than a ton of coal, the oil is the cheaper." Moreover, he says, "no fireman is needed," and this means another saving in using oil. There are many other points in favor of using oil: "It need not be shoveled from the car to the cart, and from the cart to the stock house, and again to the boilers. Oil transports itself, and dumps itself into storage tanks at the works; is pumped up daily into a feed tank on which is a registry of consumption, and from the feed tank it flows under the boiler in quantity regulated by the engineer. The degree of heat can be [illegible] regulated, and when the valve is once set to a proper supply it need not be touched for hours, and the hand on the steam gauge will stand as immovable as a painted hand on a painted dial.' It responds [illegible] to the demand for steam than coal. There is no opening of doors for the introduction of fuel, therefore no fluctuation of [illegible] pressure, no [illegible] boilers. Electric [illegible] essential this [illegible] steady light, and to the [illegible] to coal miners, [illegible] are the dirt [illegible] of coal, but with oil fuel the boiler room can be kept as neat as the parlor, and the operatives as clean as dudes. Though the odor is not precisely the fragrance of a geranium, it is neither offensive nor unhealthy. Your fire is clear pure white; without ashes, smoke, cinder or soot; nearly free from sulphur and other injurious substances; needs neither stirring nor encouragement, but burns as evenly as a gas jet, as hot as Africa, and safer than natural gas."

AN article describing an electrolytic method of purifying sewage, which has been recently tried with great success in England, appears in another column. It is admitted that hitherto no promising results have been obtained by chemical processes. Unless the representatives of the press, who investigated this system of Mr. Webster are greatly mistaken, the process is in all ways practical, and can be readily utilized in solving the vexatious problem of sewage disposal in London. The first question which naturally suggests itself in connection with a process of this kind is one that relates to expense. The estimated cost of the purifying process, according to Mr. Webster, is $3.25 per million gallons of sewage. This figure does not include, we believe, anything but actual working expenses. At this cost the process is thoroughly carried out, and the effluent, experts find, is remarkably pure. The total sewage of London is 78,000,000 gallons per day. At several times the estimated cost, the treatment by Mr. Webster's process, would be less than the cost of the chemical treatment. Several contemporaries have predicted that Mr. Webster's process will revolutionize methods of dealing with sewage. This prophecy is scarcely warranted perhaps, but certain it is that the new process gives promise of solving a most serious problem.

JUDGE WALLACE'S opinion in the injunction suit of the Western Union company against the New York Board of Electrical Control, is given in another column. The question decided has more than a local significance, and it will undoubtedly be quoted extensively in future suits involving the burial of wires. Briefly stated, Judge Wallace holds that the Western Union must obey the Board of Electrical Control in respect to removing its poles and wires from the streets, but that the company's use of the elevated railroad structure to string its wires on must not be interfered with. Judge Wallace sustains the company's contention that it is a business agency of the national government, having complied with the law in erecting its poles and wires in the streets of New York, and in stringing wires on the elevated roads, which are also district post roads of the United States. The company is therefore protected from state encroachments on its right to occupy its lines. But it is not beyond the operation of the reasonable police regulations framed by the state for the health, comfort and convenience of the public. It can object only to such legislation as interferes materially with its business and incapacitates or unreasonably impedes it in the exercise of its Federal privileges or duties. Though the company may be subjected to expense and inconvenience by burying its wires, Judge Wallace holds that the grant of congress is no more invaded, when the regulation requires the wires to be placed in conduits under ground, than it would be if they were required to be placed in conduits along the surface of the streets; and when this becomes necessary for the comfort and safety of the community, such a regulation is as legitimate as one would be prescribing that the poles should be of a uniform or designated height, or should be located at designated places along the streets. But it is another question when the right to maintain wires on the elevated railway structures is attacked. The power to remove the wires altogether from these structures and to refuse to permit them to be kept there under any circumstances is not regulation, but is equivalent to a complete denial of the privilege. The decision is considered a great victory by the members of the Board of Electrical Control. It is stated that the underground work will now progress rapidly. A New York gentleman has made the estimate that over $3,000,000 will be expended for cable in the next year.

Electric Motor on a Drawbridge.

One of the latest appliances of the electric motor which has excited much interest not only from its novelty, but also the excellence of its operation, is that of the turning of drawbridges. This is a matter to which a good deal of attention has been given both by bridge and electrical men, but it was not until recently that the motor for this purpose supplanted steam, and the slow laborious method of the long lever worked by two or three men. One installation, the details of which are shown in the accompanying cuts, has recently been made at Bridgeport, Conn., by the New England Electric Supply company. The drawbridge is 180 feet long, 60 feet wide, and weighs 320 tons. It was formerly operated by three men, but this method was found to be open to serious objection and attended by considerable expense, as it necessitated the constant attendance of the men, and under the most favorable circumstances it took six minutes to open and close the draw, which caused a jam on both sides and seriously interfered with traffic. The problem of applying electricity as a motive power has been worked out to the satisfaction of the city officials and the bridge builders. The draw can be opened and closed in two minutes, and the expense is limited to the hiring of one man and the monthly charge of the electric light company.

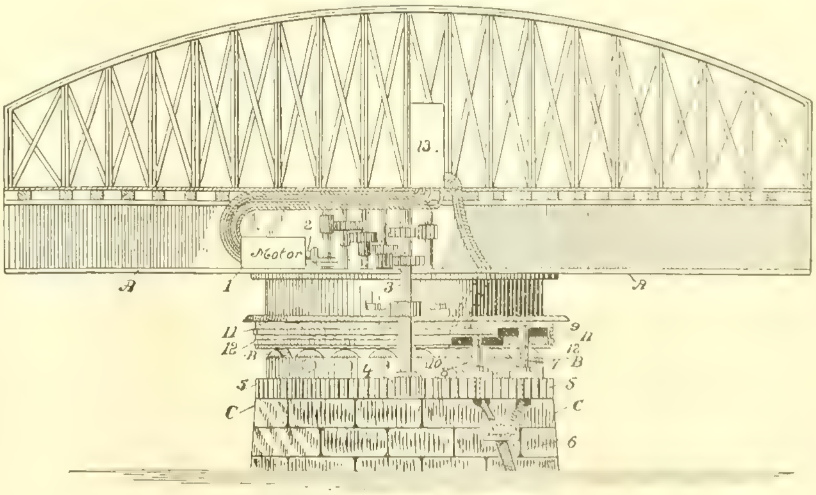
The details of construction are as follows: The current is conducted to the motor through two submarine cables, the core being equal to No. 4 B. & S. copper wire, protected from lightning by two Thomson-Houston lightning arresters. The shore ends are connected to the incandescent lighting current of the Bridgeport Electric Light company by a double pole switch, so that the current may be shut off at the pleasure of the draw tender. The other ends are connected to vertical stationary posts which are carefully insulated from the structure, and which carry on their upper ends a pair of brushes which are in contact with two insulated copper bands attached to the circular support of the draw, and moving with it. A rheostat is used to regulate the speed of the motor, and a reversing switch to change the direction of the movement of the armature. The armature rheostat and field are connected in series. The double switch, fuses, reversing switch and rheostat are inclosed in a water-tight box in the frame work of the bridge, and are easily accessible from the road bed. The bridge tender has everything under complete control, and can easily regulate the speed and direction of the [illegible] drawbridge.

The motive power is furnished by a 7 [illegible] power Thomson-Houston motor, securely [illegible] ered to the draw by iron braces. At [illegible] end of the motor shaft is a pinion [illegible] a train of gears, the last of which [illegible] shaft formerly operated by the men. The installation is complete in every detail [illegible] operation is entirely successful. Patents [illegible] devices used have been applied for. The New England Electric company expects to make several installations of like character.

ELECTRIC MOTOR ON A DRAWBRIDGE.

Electric Lights for the Chesapeake & Ohio Railroad.

J. B. Haller, electrician of the Chesapeake & Ohio railroad system, is at Pullman, Ill., where a large number of coaches are being built for his company and fitted with electric lights. On June 1st the C. & O. hopes to have fifty seven cars lighted by electricity on its road. The Eichemeyer dynamo, Brotherhood engine, Electrical Accumulator company's batteries and the Sawyer-Man incandescent lamps have been adopted. The system will be practically the same as that in operation on the Santa Fe and Pennsylvania roads, already described in the Western Electrician.



ELECTRIC MOTOR ON A [illegible]

The Chicago Electric Club.

[illegible] th the convenie [illegible]

[illegible] of the Central Union Telephone company; [illegible] of the City Fire Alarm department; Charles D. Shain of the United States Electric Lighting company; [illegible] of the Chicago Telephone company; Joseph Uhrig of the Western Union Telegraph company.

Following the receipt of the articles of incorporation, several meetings were held in an office in the [illegible] building the organization of the club effected and the following officers elected. Later on the various committees were added, as occasion required:

President.—General A. K. Stiles.

Vice-Presidents.—C. A. Brown, [illegible] Barrett, B. E. Sunny, F. G. Beach.

Secretary.—W. A. Kreidler.

Treasurer.—Franklin S. Terry.

Managers.—C. A. Brown, chairman; F. S. Terry, W. A. Stiles, W. A. Kreidler, B. E. Sunny, E. B. Chandler, G. A. Beebe, H. Ward Leonard, W. L. Armstrong, W. J. Barclay, J. P. Barrett, Chas. D. Shain, Wm. [illegible], F. W. Cushing, Geo. H. Bliss, S. A. Treat.

Membership Committee.—C. A. Brown, W. L. Armstrong, W. A. Kreidler, Chas. D. Shain, F. S. Terry.

Entertainment Committee.—H. Ward Leonard, A. H. Brown, J. L. Barclay, Chas. D. Shain, C. C. Haskins.

Finance Committee.—C. A. Brown, chairman, F. S. Terry, C. D. Shain, H. Ward Leonard, W. A. Kreidler.

House Committee.—F. B. Badt, chairman, F. W. Cushing, Frank Stewart.

Room Fitting Committee.—Frank Stewart, F. S. Terry.

The first regular meeting was held at the Grand Pacific hotel on Thursday evening, June 2, 1887, General A. K. Stiles presiding. A week later a meeting was held in one of the parlors of the same hotel, at which twenty-nine members were present, and it was unanimously resolved to hold a banquet at the Grand Pacific on the evening of June 18, 1887. To this feast, prepared under the skillful direction of H. Ward Leonard, J. L. Barclay and A. H. Brown, forty-eight members and guests sat down, and a pleasant and profitable evening was passed, and all present pledged themselves to insure the success of this, the fourth electrical society started in Chicago.

On July 1, 1887, the club lost its first member in the death of the popular young electrician, [illegible], of the firm of Johnson, Holland & Co., who was accidentally killed while in the discharge of his duties. [illegible]

[illegible] unworked Terri- [illegible] had been done [illegible] Following [illegible] Leonard opened an [illegible] effects of the [illegible] Badt was re- [illegible] the same sub- [illegible]

[illegible] absence of many of [illegible] electrical con- [illegible] did not take place [illegible] 22, 1887, General [illegible] the business was [illegible] The Danger to [illegible] by Prof. F. B. Badt. [illegible] facts presented [illegible] the discussion that [illegible]

[illegible] Sept. 26, 1887, Prof. F. B. Badt presided, and C. C. Haskins read a paper on the "Peculiarities of Electric Currents," containing valu- [illegible] the subject dis- [illegible]

[illegible] Monday, Sept. 19th. A long discussion on the desirability of new quarters ended [illegible] composed of W. J. Buckley, W. A. Stiles and Charles D. Shain, to select a [illegible] the club. Elmer A. Sperry [illegible] exhaustive paper on [illegible] getting," showing by a series of experiments what [illegible] was being done [illegible]

[illegible] A. K. Stiles [illegible] the meeting on Octo- stated that the membership had increased to 201, an actual [illegible] last meeting. Does [illegible] work done in those [illegible] than seven months' [illegible] interesting and in- structive paper on "Automatic Temperature Regulation," [illegible] value of devices that keep [illegible] the desired number of degrees. [illegible] The club had [illegible] given one banquet, and had aided in the dissemination of technical knowledge by the individual preparation and presentation of ten papers on various subjects.

The present club rooms were formally opened January 7th [illegible] of a committee con- sisting of H. Ward Leonard, [illegible] A. H. Brown, C. C. Haskins [illegible] The evening was pleasantly passed. A musical programme was presented, after which the members enjoyed a supper.

On January [illegible] read an able paper on Patent Law. At the meeting of February 6th, Dr. George Whitefield gave an interesting description of the electrical appliances used in dentistry. He spoke of the fact that when amalgam and gold fillings were used as fill- ing material, an electric current was generated which was destructive in its effects. At this meeting a committee of ten was appointed to entertain such delegates of the National Electric Light association as might stop in Chi- cago on the way to the Pittsburgh convention. It is need- less to add that the committee discharged its duties ad- mirably.

On March 5, 1888, C. A. Brown presided, and the club had the pleasure of listening to the first of a series of papers discussing the relative merits of the alternating and the continuous currents for central station lighting. H. Ward Leonard, then connected with the Edison company, opened the discussion by reading his valuable paper on "The comparative value of the continuous and the alternating current systems for the commercial distribu- tion of electricity." Mr. Leonard was paid a high compli- ment "in being greeted by the largest assemblage of members and guests that had gathered at any stated liter- ary meeting of the club since its origin."

Two weeks later, March 19th, M. M. M. Slattery of the Fort Wayne Jenney Electric Light company, in a paper [illegible] the [illegible] of "Alternating versus Continuous Currents," presented the [illegible] advantages of the alter- nating system [illegible] replied to Mr. Leonard's able [illegible]

[illegible] Monday, April [illegible] C. A. Brown presiding, the club [illegible] moving into new quarters, as [illegible] the entrance way and in [illegible] forthcoming. The [illegible] authorized to act in the [illegible] F. [illegible] of the Western Electric com- [illegible] interesting and [illegible] value of the con- [illegible] systems of electrical [illegible] [illegible] [illegible] for the [illegible] [illegible] and that the [illegible] [illegible] of the [illegible] [illegible] is nothing

of the club have awakened widespread interest both in America and Europe."

The fourth of this series of papers was presented to the club on the evening of April 23d, President A. K. Stiles presiding. Prof. F. B. Badt, then with the United States Electric Lighting company, read his eminently able paper on "The comparative value of the alternating transformer and continuous current systems for central station lighting." The professor defined his position at the out- set in saying: "I do not believe, by any means, that the alternating transformer system will be substituted for isolated lighting, or for lighting within moderate distances, but I do believe that for an economical central station lighting system, the alternating transformer system is the best in existence."

April 16, 1888, C. A. Brown presided, and the board of managers reported that it was deemed "best for the club to remain in its present quarters, and to lease the whole floor at $1,500 per year, and that some arrangements tending to the reorganization of the cafe had been effected." Vice- president Brown then called the secretary to the chair, and offered a resolution endorsing the patent legislation then before congress. Discussion resulted in the resolution being unanimously adopted. C. H. Rudd then read his paper entitled "A device for testing arc light circuits to discover leaks to earth," giving a highly interesting de- scription of a scientific but simple device applicable under all circumstances.

Monday evening, May 7, 1888, the secretary re- ported that the membership had fallen to 120, a loss of nearly 100 members in four months. This loss was readily traced to the location and to the wretched cafe service, and steps were again taken to improve the latter. At this meeting an amendment to the by-laws was adopted, fixing the initiation fee at $10 and the annual dues at $16. It was also voted to hold the annual meeting on the third Thursday in June.

The club then listened to the excellent and interesting paper on "The Continuous Current, Limited, *vs.* The Alternating Current, Unlimited," prepared by George Cut- ter of the Thomson-Houston Electric company, being the fifth of the able papers of the series. Mr. Cutter proved himself an able advocate of the alternating system, believ- ing its advantages unlimited.

Two weeks later, May 21, 1888, Elmer A. Sperry of the Sperry Electric company read the sixth paper bearing on the subject of "The Continuous Current *vs.* the Alternating Cur- rent," presenting the same under the title, "Motors and Alternating Currents." Mr. Sperry was confident that motors could be constructed which could be operated on alternating circuits.

The annual meeting of the club was held June 21st. The secretary read his report showing the excellent work which had been accomplished during the year. He referred to the importance of maintaining the club, and adverted to the social, scientific and business advantages which accrued to its membership. Treasurer Terry's report showed that the organization was on a sound condition financially. The following officers were elected:

President, L. A. Barton.

Vice-presidents, first, C. A. Brown; second, J. P. Bar- rett; third, B. E. Sunny; fourth, H. Ward Leonard.

Secretary, W. A. Kreidler.

Treasurer, F. S. Terry.

Managers: C. D. Shain, F. E. Degenhardt, E. B. Chandler, J. H. Reid, Theo. P. Bailey, A. K. Stiles, C. C. Warren, W. J. Buckley, M. A. Knapp, George L. Beetle.

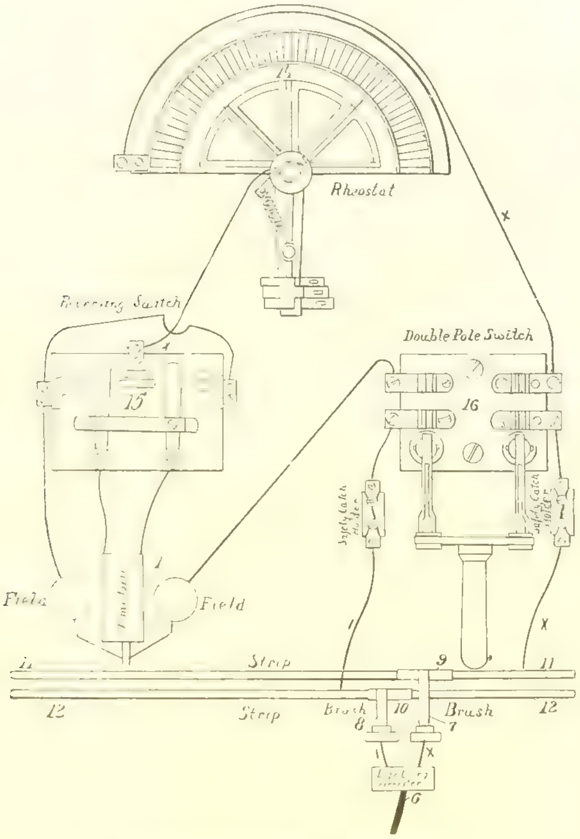
Membership Committee: C. C. Haskins, J. W. Clark, George Cutter, W. H. McKinlock, F. W. Horne.

On July 30th the newly elected president, S. A. Barton, spoke of the advisability of establishing an electric ex- change similar to the New England Electric exchange at Boston. B. E. Sunny, C. A. Brown, C. D. Shain, J. P. Barrett and F. W. Horne were appointed a committee to consider the matter. At the meeting October 1st, S. A. Duncan, president of the National Electric Light associa- tion, was present, who spoke of the necessity of securing a permanent home for the club. On October 29th C. C. Haskins read a paper on the "Universality of Vibrations," and at the meeting of December 17 Dr. George W. White- field read an interesting paper on "Injurious Influences of Dissimilar Metals used as filling material in the mouth." Thus ended the year 1888. During the last half of the year only three regular meetings had been held. A number of the most prominent members had resigned, and the membership had decreased to about 120. There was a de- ficiency of $200 in the club treasury.

During the summer C. C. Haskins was appointed the custodian of the club, with power to collect and receipt for all dues, to have general charge of the rooms, and to take such steps as will advance the interests of the club. The wisdom of his action was at once shown in improve- ments that followed.

But though the outlook for the new year was not as bright and prosperous as at the beginning of the preceding year, yet never did a club rally in better shape, or display more energy in doing so. On the three first Mondays in the year the club met and discussed the important question of "Insulation," and listened to the reading of valuable papers thereon. So important was the subject, and so thoroughly was it handled, that the technical journals both in this country and in Europe freely commented thereon and made copious extracts from the printed proceedings. What has occurred since then, with all its importance, is too fresh in your memory to need any recall.

The club membership stands to-night as follows: Resi- dent members, 124; non resident members, 23; members who are yet to qualify, 23; giving a total membership of 170. Including unpaid dues, there is a balance on the right side of the club book of $100, after allowing for all indebtedness incurred to date. These figures, coupled with the fact that [illegible] applications for membership were received during the past week indicate the prosperous condition the club now enjoys. Your worthy president has spoken earnestly and often in behalf of better quarters, and when the mists of April shall have cleared away you



[illegible] MOTOR [illegible] WEAVER [illegible]

[illegible] that twenty-three [illegible]

will gather in a home worthy to be [illegible] club that has won the good name that you have gained [illegible] its spurs in the first year of its existence.

In that new home you will have full and free entrance through your own rooms into the finest restaurant in the west; or, if you prefer, you can be served in your own rooms with all you desire. You will have apartments furnished in harmony with your tastes.

Let us become so bound up in the interests and the welfare of the club that it shall become part of ourselves, and our new home will then become *the* point to which we shall constantly be drawn, and the club, as a club, will continue to be a financial, a social and a literary success. It will become a power among men and [illegible] influence for good in educating the business public to rightly appreciate the value of electricity, in all its branches, as a practical and profitable medium for the safe investment of capital.

For your city is fast becoming the great city of the world, and will soon be the Mecca towards which all scientists will travel, and then the greatest among these wise men will gladly knock for admittance at the door of your club, and will add their influence and their labors to yours in promoting the welfare of your club, and so the good work shall go on through all time.

Victory of the Board of Electrical Control.

Judge Wallace, in the injunction suit of the Western Union Telegraph company against Mayor Grant and the New York Board of Electrical Control, decided April 12th that the plaintiff must remove its poles and wires from the street, but that its use of the elevated railroad structure must not be interfered with by the defendants

The claims of the Western Union Telegraph company raised questions of more than local interest Those claims, briefly stated, are that its contract with the United States government exempted it from any interference by the city or state, and that its long-continued occupancy of the streets gave it an easement which amounted to actual ownership, affecting every city which may attempt to bury or otherwise regulate telegraph wires. The first claim was based upon an act of Congress, "to aid in the construction of telegraph lines and to secure to the Government the use of the same for postal, military and other purposes." This act provided that any telegraph company then organized, or which might be organized, in any state, which should file with the Postmaster General an acceptance of the terms of the act, should have the right to construct lines along any post road in the United States declared by law to be such. The Western Union company claimed that, having complied with all the terms of the act of 1866, its right was clear over all post roads in the United States, including all the streets in New York city, the latter being "duly designated letter-carrier routes."

The purely local features of the Western Union company's complaint were: First, that the Consolidated Telegraph & Electrical Subway company, being a monopoly, was not legal, and that the subways therefore have no existence in law; second, that the conduits are inadequate because of mechanical defects.

The legal points were reviewed at length by Judge Wallace, who introduced his opinion with this statement:

This case presents the general question whether certain acts of the municipal authorities of the city of New York respecting matters of grave local concern, done or about to be done pursuant to powers devolved upon them by the legislature of the state, are such an invasion of the paramount authority of the National government as to render them unwarranted. The mere statement of this proposition shows that the complainant has properly invoked the jurisdiction of this court, and has a right to rely upon its interposition by injunction, if the acts of the defendants are thus unwarranted, are injurious to the complainant, and are of a nature revocable by cause of equity.

He then reviews the conditions under which the telegraph company exists, and sustains the company's claim that all streets are post roads in the meaning of the law, and defines the status of the company as follows:

A telegraph company occupies the same relation to commerce as a carrier of messages that a railroad company does as a carrier of goods. Both companies are instruments of commerce, and their business is commerce itself. Telegraph companies are subject to the regulating power of Congress in respect to their foreign and interstate commerce, and this power resides exclusively in Congress. The complainant has been engaged in interstate and foreign commerce In the course of its operations the complainant has lawfully erected its poles and strung its wires in and along the streets of New York city, which, as has been stated, are post roads of the United States, and it has also put up and now maintains over and along other streets a number of wires upon the structures of the Manhattan Railway company, an elevated railway of the city, also a post-road, pursuant to a lease from the railway company. The defendants (the Mayor and Board of Electrical Control), assuming to proceed by the sanction and mandate of certain acts of the state legislature have compelled the complainant to remove its poles and wires from some of the streets, and have notified it to remove them from other streets, and to remove its wires from the structures of the elevated railway, and they purpose if the complainant fails to comply with these requirements to remove the poles and wires themselves. Under these circumstances the complainant asks this court to examine the authority under which this destruction of its property is threatened, and determine whether there is any justification in law for acts which apparently invade the privilege to maintain and operate its lines upon the post-roads of the United States, interfere with its operations as a Government agent, and interrupt and impede the discharge of its functions as an instrument of interstate and foreign commerce.

Judge Wallace rules that the company is therefore entitled to national protection against any encroachments of the state authority upon the rights or immunity granted by [illegible] from [illegible] States [illegible] the [illegible] Western Union [illegible] language [illegible] Congress.

It gave [illegible] corporation the [illegible] private property [illegible] necessary [illegible] that [illegible] state legislation shall prevent the occupation of post [illegible] for telegraph purposes by such corporations [illegible] to avail themselves of its privileges.

[illegible] that the [illegible] power by taxation or otherwise to retard, impede, burden or in any manner control the agencies of the Federal [illegible] ernment, and they are exempted from the effect [illegible] legislation [illegible] that legislation [illegible] impair the [illegible] in performing the [illegible] they are designed to serve the government. Continuing, the [illegible]

Nevertheless, persons and corporations enjoying [illegible] and privileges from the United States, exercising Federal agencies, and engaged in interstate commerce, are not beyond the operation of the laws of the state in which they reside or carry on their business; and it is only when these laws incapacitate or unreasonably impede them in the exercise of their Federal privilege or duties and transcend the powers which each state possesses over its purely domestic affairs, whether of police or internal commerce, that they invade the natural jurisdiction.

The state laws bearing upon the subject of burying wires are reviewed and the powers conferred thereby analyzed, and the conclusions reached by the court are set forth as follows:

It was said of the acts of 1884 and 1885 by the Court of Appeals (People vs. Squire, 107. N. Y.. 593) that they sprang out of a great evil which in recent times has grown up and afflicted large cities by the multiplication of rival and competing companies, organized for the purpose of distributing light, heat and water, the transportation of freight and passengers and facilitating communication between distant points, and which require in their enterprises the occupation of not only the surface and air above the streets. but indefinite space underground. This evil had become so great that every large city was covered with a network of cables and wires, attached to poles, houses, buildings and elevated structures, bringing danger, inconvenience and annoyance to the public. The necessity for a remedy for these public annoyances had long been felt, and it finally culminated in the enactment of the several statutes referred to. These statutes were obviously intended to restrain and control, as far as practicable, the evils alluded to, by requiring all such wires to be placed under ground in such cities, and be subject to the control and supervision of local officers who could reconcile and harmonize the claims of conflicting parties, and obviate in some degree the evils which had grown to be almost, if not quite, intolerable to the public.

The act of 1887, by validating the contract between the commissioners and Subway company, in effect incorporated the terms of that contract into its provisions. But the statute is none the less an exercise of the police power and within the competency of the legislature, because of the special privileges given to the Subway company. It has been urged that in effect this statute confiscates property rights of the complainant and other companies owning electric wires, by depriving them of their easements for the benefit of the Subway company, and, therefore, cannot be sustained as an exercise of police power. But in the Slaughter House cases (16 Wall, 36) the Supreme Court upheld a statute far more obnoxious to these objections than the present act.

In dealing with the claim by the company that a monopoly had been granted the Subway Construction company, Judge Wallace says:

It has also been objected to the act of 1887 that it contravenes section 16 of article 3 of the state constitution prohibiting the legislature from passing any local bill granting to any corporation any exclusive privilege, immunity or franchise. Without intending to intimate that such a question is properly to be considered by this court in the present case, it is proper to say that the objection seems to be without substance. There is nothing in the contract with the Subway company that precludes the commissioners from building subways or entering into contracts with other companies for building them, similar to the one made by the Subway company. The contract only extends to such subways as the commissioners shall direct the Subway company to build, and it provides in express terms that nothing in it shall be construed as granting to the Subway company any exclusive privilege or franchise.

The question is whether or not these statutes unreasonably abridge or burden privileges and immunities which the complainant derives from the general government. In whatever language a statute may be framed its purpose must be determined by its natural and reasonable effect and these statutes are to be judged by the extent of the powers which they confer, and treated as police regulations only to the extent to which their operations can be justified by the police power of the state. Undoubtedly, in carrying them into effect, the complainant will be subjected to great expense, temporary interruption of its business, and possibly to permanent inconvenience and loss in conducting its business. But, after all, the question is merely one of the reasonableness of the regulation, and whether the losses and inconveniences to which the complainants may be subjected are not such as may justly be exacted of every citizen or property owner for their common good. It is a settled principle, growing out of the nature of well-ordered society, that every holder of property, however absolute and unqualified may be his title, holds it under the implied liability that his use of it shall not be injurious to the equal enjoyment of others having an equal right to the enjoyment of their property, nor injurious to the rights of the community.

This liability is quite irrespective of the source of what [illegible]

[illegible]

than it would be if they were required to be placed in [illegible]

[illegible] and property within the state is subject to the operation of the former so long as it is within the regulating restrictions of the latter. In [illegible] 125 [illegible] intended by the Congress of the United States, in conferring upon a coproration of one state the authority to enter the territory of any other state and erect its poles and lines therein, to establish the proposition that such a company owed no obedience to the laws of the state into which it thus entered and was under no obligation to pay its fair proportion of the taxes necessary to its support." It is not apparent how the regulation proposed impairs in any just sense the privilege granted to the complainant by the law of Congress.

Relating to the claim that the Board of Electrical Control and [illegible] right to interfere with wires on the elevated railway structure, the opinion says:

There is serious doubt whether the powers conferred by the statutes in the case are not migratory to the extent that they permit the complainant to be deprived of its right to maintain its wires upon the structures of the Elevated railway. That railway is an independent post-road of the United States, in legal contemplation, carved out of the streets upon which its structures are erected; and state legislation, under whatever power it may be classified, is impotent to destroy the privilege given by the act of Congress. The power to remove the wires altogether from these structures and to refuse to permit them to be kept there under any circumstances is not regulation, but is equivalent to complete denial of privilege.

After alluding to the charges that the subways are insufficient, which the judge says is denied by the defendants, the opinion concludes:

The well-settled doctrine concerning the exercise of duties by public officers is that so long as they confine themselves to such as are confided to them by law the court will not interfere to see whether they are acting wisely or [illegible]. An order will be entered denying an injunction and vacating the stay heretofore granted as respects the removal of the complainant's poles and wires from the streets, and granting an injunction against any interference by the defendants with the complainant's use of the structures of the Manhattan Railroad company for operating and maintaining its lines.

Julien Storage Battery Cars.

The Julien Electric Traction company has just made public interesting data concerning the [illegible] storage battery cars on the [illegible] Avenue line in New York city. The last car which was put on the line makes [illegible] trips, or [illegible] miles [illegible]. During the [illegible] days in which it has been in operation its receipts in cash have been [illegible], an average of [illegible] per year. The average earnings of horse cars on the [illegible] are [illegible] per annum, or $2,71[illegible]25 less than the [illegible] car. Allowing $4 a day for the [illegible] and [illegible], $3 [illegible] per day for motive power, wear and tear [illegible] $3[illegible] per year interest, the net earnings would be $[illegible]672.75. These net earnings will more than pay the entire cost of the car and its equipment at the end of the first year. During the time the car has been [illegible] of the batteries nor the motors have [illegible] the expenditure of one dollar [illegible]. Even the [illegible] have not been changed [illegible] any wear. Car No. 1 on [illegible] Avenue [illegible] service on September 3d, and on April 8th its [illegible] examined for the first time. [illegible] been [illegible]. They were found to be in as good [illegible] were put in service [illegible] a single [illegible] battery during the year [illegible].

[illegible]

CORRESPONDENCE.

New York Notes.

[illegible]—The Callender Insulating & [illegible] getting on its feet [illegible] here from England [illegible] There is [illegible] of the company [illegible] light. I understand [illegible] successful business in [illegible] A special examina- [illegible] is being made by a [illegible] It will make its re- [illegible] meeting of the editors, at the Astor house.

[illegible] New York Electrical society was [illegible] when the matter of increasing the membership and usefulness of the organization was discussed. This society is becoming prominent in the electrical field, and is doing excellent work.

The annual election of officers of the Electric club will take place Thursday, April 18th. An excellent programme has been arranged for the entertainment of the members, and an elaborate dinner will be served.

[illegible] Wheeler [illegible] report to the Board of Electrical Control, reported to Mayor Grant the early part of the [illegible] conduits in Broadway, Sixth avenue, and Twenty-third street, which have been operated [illegible] the United States Illuminating company since last Friday night are in better condition than when first used, and seem to be steadily increasing in insulation. The same is found true of the Manhattan Electric Light company's wires in Broadway, from Fifteenth to Thirty-fourth streets. In the opinion of Mr. Wheeler, the wires which are not overloaded are improved in effectiveness by the passage of the electric current through them, and he reports to the mayor that "the extension of the underground system is progressing with gratifying speed."

Chauncey M. Depew, president of the New York Central Railway company, has informed Mayor Grant that the fire department may place its wires in the Fourth avenue railway tunnel.

At a meeting of the Board of Trade and Transportation yesterday, the report of the legislative committee and the failure of the Hamilton bill reducing the price of the rent of the telephone in New York was discussed.

The question of rapid transit for this city, which has [illegible] the legislature at Albany, is still occupying the attention of New-Yorkers. Mayor Grant's bill will come up in the senate Tuesday for a third reading. In the discussion on the bill last Tuesday the members indulged in personalities, and gave little attention to the merits of the proposed bill. It is doubtful if it can be amended in the senate, though strenuous efforts to amend [illegible] every New York and Brooklyn senator will vote for the bill, but it needs other [illegible] satisfaction with the present systems is so [illegible] must soon be a change. [illegible] if the elevated or surface roads gave excellent service, it could hardly be expected that the people would [illegible] they occasion. The [illegible] considered practical [illegible] apparent that in the development of the elec- [illegible] improvement over [illegible] electric railway [illegible]

[illegible] decision of Judge [illegible]

[illegible] They [illegible] wires in [illegible] company [illegible]

and for 287 lamps where it has no poles and wires or per- [illegible] for 530 lamps on streets not included in the advertisement. The Harlem Lighting company, eighty-nine lamps at 30 cents and 60 cents, and the North New York company, twenty-eight lamps at 35 cents and 60 cents, were the only bidders in these neighborhoods.

The preparations for [illegible] the city by electricity on the [illegible] all are the most exten- [illegible] curious and beautiful devices have been prepared, and visitors will have an opportunity to see the extent of the development of electric lighting in the metropolis. W. H. T.

Milwaukee, Wis.

MILWAUKEE, April [illegible] M. Quaide, secretary and treasurer of the National Conduit company, has been in the city superintending the construction of the underground cable system. The system is to be used for arc lighting by the Western Electric company. The Standard Underground cable will be used. It is expected that the system will eventually be extended throughout the city.

The demand for electric lighting in Milwaukee has taken a boom compelling the Badger Electric Light company to double its plant. It is at present running nine dynamos, Thomson-Houston system, furnishing 330 lights. Two incandescent dynamos will soon be added to this system by the Thomson-Houston company of Chicago.

L. W. C.

Indianapolis, Ind.

INDIANAPOLIS, April 13.—The underground wire question is now agitating the councilmanic mind. At Monday night's session the council committee on public light, to which have been referred several ordinances relating to electric lighting, more particularly incandescent, reported against allowing any more overhead wires to be put up, and recommended that the special privileges granted the Brush company be revoked. The committee is strongly in favor of placing all wires underground. The report was laid over until next week.

On Saturday night a meeting of council and aldermanic committees, appointed to confer with property owners on Illinois street and the Street Car company's officials, will be held. It is expected they will arrive at some conclusion in regard to the placing of electric motors on that line. The question seems to hinge on the extension of the company's charter. They have promised to put in a motor system on the line, provided the charter is extended 50 years. Many of the councilmen are opposed to this, and also the overhead system which the company intends to use, though they will probably allow this if an agreement can be arrived at with street car people. M.

Boston, Mass.

BOSTON, April 13.—At the annual meeting of the New England Electric Exchange in this city Monday the following officers were elected for the ensuing year: President, P. H. Alexander; secretary and treasurer, Henry B. Cram; directors, P. H. Alexander, Henry B. Cram, Frank Ridlon, A. Robinson and J. V. Bradbury. The annual report of the treasurer showed a balance of $41. In reviewing the history of the first year of the exchange, the president said: "It is just a year since the New England Electrical Exchange was formed, and it is but proper that we review to-day, its first anniversary, the work that has been done by it. Many of you who are here to-day will doubtless remember the meeting held the 9th day of April last year, the difficulties we had in laying out the work of the exchange, and the hopes and fears that were expressed for its future. In the first few months of our existence the purposes and aims of this institution were misunderstood, and attacks upon this exchange were of frequent occurrence. While it is true that all the objectors have receded from the position taken, after investigating thoroughly the work that had been done, and was contemplated to be done, it is nevertheless true that many men who at first evinced much interest in the purposes [illegible] have let their interest [illegible] have left the burden that [illegible] on the shoulder of [illegible] self-interest to the [illegible] how outsiders look [illegible] recollect, [illegible] among the electric [illegible] insurance men of [illegible] determination to [illegible] where electric [illegible] ed them, as you know, [illegible] they not only needed [illegible] that after May 1, 1889, every man operating a dynamo or installing electric light and power must hold a license certificate from this exchange, should the owner of the building desire any insurance upon the property. And when we asked the legislature for a charter to incorporate this organization, these very same men went before the committee on mercantile affairs and demanded that such incorporation be granted, as it would increase security against fire risks and decrease danger to life and limb, feeling that any one that could secure a license from this exchange was a man to be intrusted with the installation of electric light appliances. A further appreciation of our work by outside parties is best shown by the attention given to the report of our exchange read before the National Electric Light association meeting held at Chicago last February, and the action taken by that body in appointing a committee to report at the semi-annual meeting of the National Electric Light association to be held next August upon resolution to recommend some means that would secure to the National Electric Light association the same advantages now obtained by the New England Electrical Exchange regarding the pleasant business relations between the electrical and insurance interests. So far 175 men have applied for licenses, 150 of whom were examined; 144 were granted certificates, 68 of whom, however, obtained a lower grade of license than they applied for, and 4 secured a higher grade, while 6 men were rejected as totally unfit to carry on the business. It will interest you also to know that of 59 who applied for first class licenses, 48 were examined, and only 29 granted a first class certificate; of the 61 who applied for second-class, 52 were examined, and only 35 obtained the class of certificate desired. The membership has increased during the past three months, and we now have on the roll eighty-six members."

At the conclusion of the business meeting a discussion of insurance requirements for electric light stations took place, and M. J. Perry of Providence read a paper on "Economical Steam Plants for Electric Lighting Stations."

Detroit, Mich.

DETROIT, April 13.—In a bill of complaint filed some time ago in the United States Circuit court for the Eastern District of Michigan, Asa W. Straight asked that Clayton & Co. be restrained from producing a furnace which had embodied in it many improvements alleged to have been invented by Straight, and therefore an infringement; that all furnaces manufactured by plaintiff bore the words, "Patent applied for." Judge Brown, before whom the case was argued, held that a court of equity has no jurisdiction to enjoin the infringement of an invention before a patent had been issued, notwithstanding an application for the same had been made was still pending in the patent office. In this case the important question was, whether an inventor can maintain a bill for an injunction before the issue of a patent. On this point the judge said: "The power of the court to deal with patents is now regulated by the patent act of 1870, from the provisions of which it is impossible to deduce any power to grant an injunction before the right has actually been secured by patent. There are also certain practical difficulties in the way of assuming jurisdiction of a bill like the one under consideration. Courts of justice have no original cognizance of the subject of inventions. It is absolutely impossible for courts of justice to deal with questions of this description. We are asked in this case to assume that a patent will be issued covering five different claims, yet we have no assurance whatever that if a patent be issued any one of these claims will be allowed in the language in which it is couched. Besides, the effect of assuming cognizance of a patent before the patent is granted would be to extend the life of the patent beyond the statutory period of seventeen years, which may be months, and even years, during which the application is pending in the patent office. The jurisdiction of courts to determine the validity of patents is purely appellate. It is obvious that when parties are represented by experienced counsel and witnesses are examined with that care and deliberation which is only attainable in judicial proceedings, a correct result is much more likely to be reached than upon the hurried examination of an examiner in the patent office. These considerations, however, do not by any means justify us in anticipating his decision or intermeddling in any way with his action before it has been consummated by the issuance or refusal of the patent. A decree will therefore be entered denying the injunction and dismissing the bill for want of jurisdiction."

The city board of Superior last evening accepted a proposition from the Superior Electric Light & Power company to furnish that city with sixteen arc lights for street illumination in return for the privilege of using the steam power at the water works to furnish the circuit. The franchise will be granted for a period of fifteen years. S. L. Felton of Omaha will be superintendent of the company. O.

THE ELECTRIC LIGHT.

The Mather Electric company will install a 1,200 light plant in the Spaulding house at Duluth, Minn.

The Miama Valley Electric company of Dayton, O., has been incorporated with $30,000 capital stock.

The Castle Shannon Railroad company of Pittsburg, Pa., is considering a plan for building an electric railway.

The Electric Lighting committee of the St. Louis Board of Public Improvements is engaged in preparing a scheme for lighting the public buildings by incandescent lamps.

The electric light station at Tacoma, W. T., was destroyed by fire recently. The greater part of the machinery was saved, however. The loss was $2,500, and there was no insurance.

The Topeka Electric Light company, which was awarded the contract for furnishing the public lights for Sedalia, Mo., has failed to file the necessary bonds, and it is probable the contract will now be awarded the local company.

James Green of St. Louis has taken possession of the Sedalia electric light works, and begun the erection of a fireproof building. The improvements will cost $50,000. The plant will be enlarged to supply the increasing demand for light.

Virginia, Ill., was lit up April 12th for the first time by electricity. Four arc lights illuminate the square, one being placed on each corner. They have been placed in nearly all the business houses. A band celebrated the occasion by giving a concert in the public square.

Rushville, Ind., is to be lighted by Edison lights on the three-wire system. Leonard & Izard secured the contract, and will install lights equal to 500 16-candle power lamps. Most of the lamps will probably be 24 and 50-candle power. No two street lights will be more than 240 feet apart.

Among recent sales of the Western Electric company, Chicago, are the following: Gaynor Electric company, Louisville, Ky., one 6-light low tension arc outfit; Alliance Gas Light company, Alliance, O., one 35-light high tension arc outfit; City of Dunkirk, N. Y., one 35 low tension arc outfit.

Falkenberg & Foster are establishing an arc light plant on Thirty-first street, Chicago. The power house is already completed, and the work of placing the dynamo, engines, etc., in position is well under way. A 60-arc light plant complete, of the Thomson-Houston company's system, has been purchased.

The Baton Rouge, La., lighting interests—gas and electric—have been consolidated. The new title of the company is that of the Baton Rouge Gas, Electric Light & Power company. The capital of the consolidated venture is fixed at $60,000, and a new electric plant is now being installed. It is presumed that the current will be turned on early in May.

The Huron, S. Dak., Electric Light & Power company has just completed the installation of a 400-light incandescent dynamo of the Thomson-Houston make, which is operated in connection with the arc plant already established. The new incandescent machinery was put in by Charles M. Allen, one of the experts in the service of the Thomson-Houston company.

Among the recent sales of the Thomson-Houston company of Chicago are the following: Grand Forks, Dak., 50-arc light plant; Benton Harbor & St Joseph Electric Light company of St. Joseph, Mich., 50 arc light plant; Aberdeen, Miss., 35-arc light plant; Cadillic, Mich., 50-arc light plant; St. Paul, Minn., 130 arc lights, 1,200 incandescent alternating lamps and 450 direct.

Waterhouse arc lighting installations are reported as follows by the Westinghouse Electric company: Central stations—Huntington, W. Va., Electric Light & Street Railway company, 70 lights; Ashland, Ore., 35 lights; Corning, Ia., Electric company, 35 lights. Isolated plants—Sacramento, Cal., Southern Pacific Railroad shops, 40 lights; Cosmopolis, Wash Ter., Gray's Harbor Mill company, 35 lights.

THE ELECTRIC MOTOR.

Work on the electric street railway at Stillwater, Minn., was commenced last week.

George Cutter of Chicago is to furnish 10,000 feet of simplex wire for the Metropolitan Street Railway plant in Kansas City.

June 1st is the date set for opening the electric railway between Rochester and Charlotte, N. Y. The Thomson-Houston system will be employed.

Pasadena, Cal., demands rapid transit, but owing to the extensive scale on which it will be introduced, it is probable that the trustees of the town will await the result of experiments in New York and other cities before adopting any particular system.

One of the most recent contracts among the large railway companies which have decided to adopt the electric railway system, is that of the Buffalo Street Railway company with the Sprague Electric Railway & Motor company of New York. The Buffalo company carries 11,000,000 passengers a year, and its indorsement of the electric railway system is regarded as a great triumph for electric power. This contract was awarded after a most thorough and careful investigation, extending over a period of several months, by President Watson and the directors of the road. Although the contract calls for a comparatively small number of cars at first, it is the intention of the company, it is understood, to increase their electric equipment and extend the system throughout their entire line when the necessary franchises and consents can be secured. This contract was secured by the Sprague company through its agent at Buffalo, Edward E. Higgins.

THE TELEPHONE.

The telephone system of Omaha [illegible] many important particulars.

The [illegible] telephone company's annual [illegible] a gain of [illegible] subscribers' stations during last year.

THE TELEGRAPH.

In Chicago last week a sharper succeeded in defrauding a number of [illegible] by inducing them to [illegible] Western Union money orders.

A dispatch from Lansing, Mich., says: Beginning May 1st the Western Union and Postal Telegraph companies will charge uniform rates for messages, the Western Union lowering its rates in some instances and the Postal raising its tariff to many points to correspond with the Western Union's prices. This action is probably safe so far as the legislature is concerned, as the two bills which seek to lower the rates are smothered in committee.

A dispatch from New Haven, Conn., April 10th, says: United States Marshal Preston to-day attached all the offices of the Postal Telegraph company in Connecticut. Keepers are now in charge of the various offices. This is thought to be the result of a decision recently rendered by Judge Shipman at Hartford in a suit growing out of some transactions of the company that preceded the United Lines and Bankers' and Merchants'. The offices are accepting telegrams.

The following news dispatch from Indianapolis, dated April 13th, is given for what it is worth: In connection with the westward inspection trip of A. B. Chandler, president of the Postal Telegraph company, and George B. Ward, president of the Commercial Cable company, who were in Indianapolis to-day, the report was published here that arrangements have been made for the consolidation of the Western Union and United Lines telegraph companies. The local representatives of the two companies say there is no truth in the rumor regarding a consolidation, but admit that an agreement has been entered into affecting rates, and it will go into operation May 1st, but they decline to give any information as to the details before publication of the matter is authorized by the general officers. From what can be learned, it is believed that in consideration of the United Lines advancing rates to many points the Western Union will withdraw the old Mutual Union from the field as a competitor.

Miscellaneous Notes.

The executive committee of the National Electric Light association has fixed upon August 6th, 7th and 8th as the dates for holding the convention at Niagara Falls.

A bill is before the United States senate authorizing the committee on patents to sit during the recess of the senate to inquire into the condition of the present system of issuing patents and the cause of delay in granting the same.

A dispatch from Sharon, Pa., says: An important test of an electric brake was made yesterday in the presence of Lake Shore & Michigan Southern railroad officials by the inventor, Jacob Harrington. The brake is controlled by a dynamo on the train, and a mere touch by the operator brings the train to a dead stop almost instantly. In case a train breaks in two a separate motor automatically stops the train. The railroad men predict the instant success and adoption of the new brake, which may be used also upon electric street railways.

The Westinghouse Electric company has recently issued a neat agents' circular containing a list of the patents controlled by the company. It shows that the company controls 554 patents, and in addition has an interest in several others. Of the number 203 belong to the Westinghouse company, and 294 to the United States Electric Lighting company, 49 to the Consolidated Electric Light company and Sawyer-Man Electric company, and 8 to the National Electric Light & Power company. The Westinghouse Electric company is the lessee of these companies.

Personal Paragraphs.

Brainard Rorison of the Indianapolis Jenney company was in Chicago last week.

J. P. McQuaide of the National Conduit company of New York, was in Chicago last Monday.

L. A. Scovil has resigned his position as foreman of the underground department of the Chicago Edison company, to accept a position with the Sprague Equipment company of Cincinnati.

W. W. Driscom, president of the Electro-Dynamic company of Philadelphia, was in Chicago Monday. Mr. Driscom is also a director of the Electrical Accumulator company of New York.

The will of the late E. P. Allis of Milwaukee disposes of an estate estimated in the millions, almost entirely invested in the Reliance Iron Works, with the exception of about $500,000 of life insurance. The main objects of the will are to keep the property intact, and to provide for the growth of his immense industrial enterprise. In the document he said: "It has long been a cherished idea of mine to convert these works into some sort of a co-operative or profit-sharing institution, but the proper method and time have never been clear for me to do so with a surety of success. I believe such an arrangement is the proper one for all concerned in its management and operation, and that it will soon be feasible, and I commend its careful investigation and, at the proper time, its adoption by my trustees." No public bequests are made, and in explanation of this the testator says: "In this will I have made no outside bequests, deeming the size of my family and the central idea of a great and publicly beneficial Milwaukee industrial institution with ample means and the family name as precluding and taking the place of any other bequests."

Business Mention.

[illegible]

[illegible] was recently described and illustrated in this paper. The [illegible] work and to construct special instruments. The department will be under the supervision of Richard O. Heinrich.

The spacious factory of the Horn, Brannen & Forsythe Manufacturing company, located at Broad and Noble streets, Philadelphia, is one of the most complete works of its kind in the United States. This firm is one of the leading houses in the manufacture of electroliers, gas and combination fixtures both in brass and wrought-iron designs, and their well-known goods are becoming deservedly more popular year by year. The location of their factory is very convenient. The tracks of the Philadelphia & Reading railroad are on the south side, and the Pennsylvania railroad's freight depot is but a few squares away. Facing Philadelphia's favorite boulevard, Broad street, the lofty five story building can be seen by any approach, presenting an imposing appearance. On the first floor are the offices, show room, warerooms and shipping rooms. The show room is magnificently decorated with every style of fixture known to the maker's art, and $30,000 would hardly replace the exhibits, if once destroyed. One particular room is devoted to the finer grade of fixtures with the glass pendant, and the slight vibration caused by the visitor's footfall makes a harmonious tinkling that is most pleasing. The upper floors are devoted to manufacturing purposes, and it is here that the artistic designs, which have brought the firm fame and substance, are fashioned. Always on the alert for something new and pleasing, this firm has ever the latest "wrinkles" in artistic fixtures, sending out more new designs than probably any other similar house. Among some of the buildings which have been fitted up with their fixtures are the Chamber of Commerce building, Cincinnati, O.; Postoffice building, St. Louis, Mo.; Post office building, Philadelphia, Pa.; Ryan Hotel building, St Paul, Minn.; besides numerous private residences, halls and buildings of more or less note in the west and southwest.

Electrical Patents.

Issued April [illegible], 1889.

400,890. Regulation of Electric Motors. Foree Bain, Chicago, Ill.

This invention relates to that class of cloth-cutting machines embracing a reciprocating knife and electric motor for actuating the same, the machine being adapted for use in cutting a number of pieces of cloth to a common pattern, as is desirable in the manufacture of ready-made clothing. The claims follow:

"1. In a cloth-cutting machine, the combination, with a reciprocating knife and a motor connected with and actuating the same, of a handle for controlling the movement of the machine, resistance coils for regulating the flow of current to the motor and an automatically acting switch or contact device located in position to be acted upon by the operator in grasping the handle of the machine, and operating to throw the said resistance coils into and out of circuit with the magnet and armature coils of the motor.

"2. The combination, with a frame of a cloth cutting machine, of a reciprocating cutter, of a motor for actuating the cutter, a handle attached to said frame for controlling the movement of the machine, a switch bar movably connected with the handle, a resistance coil, contact points upon the switch bar and handle, and conductors connecting said contact points with the resistance coil and with the field and armature coils of a motor."

400,911. Telephone Support. [illegible] Hall, Detroit, Mich.

400,916. Current Collecting Device for Electric Railways. Rudolph M. Hunter, Philadelphia, Pa.

400,917. Thermal Circuit Closer for Fire Alarms. Armand C. Iwanowski, Moscow, Russia.

400,920. Electric Railway. Robert Lunde, New York, N. Y.

The first and last claims are appended:

"1. The combination with a [illegible]

"18. In an electric railway, the [illegible]

400,951. Electric Circuit Testing Device. Miner Rob- [illegible]

[illegible] Conduits. John A. [illegible]

[illegible] B. Thayer, New [illegible]

The invention consists in building up the springs or contact pieces of the switches in banks or layers with rubber strip interposed between the different layers, so that the different contact pieces of each switch will be properly insulated, and at the same time brought within as small an area as possible. [illegible]

"3. The combination in a spring jack switch, of three springs or contact pieces placed in different parallel planes one above the other, the upper one of said springs being connected with the test piece or socket of the switch and the central spring normally resting against a point of the lower spring, and a plug which, when inserted, lifts the central spring from its normal contact with the lower spring and forms connection therewith, while the test piece is at the same time connected with the shank of the [illegible]

[illegible] Alternating Current Electric Motor. Elihu Thomson, Lynn, Mass.

The invention consists in a motor in which the reaction between an alternating current field and the currents electric and magnetic induced thereby in a closed circuit armature are employed to impart movement to either or both elements of the apparatus.

"Claim 4. In an alternating current electric motor having a closed electric circuit for induced currents, by the reaction of which on an inducing alternating field the motor is operated, a laminated external ring magnet, in combination with a laminated internal magnet formed, as shown and described, with a central reduced portion for the coils and enlarged polar portions conforming to the circular internal line of the outer ring magnet, both said magnets being wound with suitable coils, one set of which is closed on itself."

400,972. Induction Coil and Self Inductive Apparatus. Elihu Thomson, Lynn, Mass.

[illegible] Armature for Dynamo Electric Machines. Elihu Thomson, Lynn, Mass.

The object of the invention is to obtain a ring armature in which the core may be a laminated structure, in which the magnetic circuit shall be almost perfectly closed, facilitate the work of construction by permitting the coils to be formed and afterward placed on the core, to permit easy repair to the winding or insulation, and to produce at the same time an armature structure which shall be symmetrical from projection from its core. The first claim is appended:

"In a ring armature for dynamo electric machines or motors, a laminated core having a notch or gap at one side for the insertion of the coils closed magnetically by a laminated plug or bundle fitted tightly into the notch or gap to complete or restore the magnetic circuit after application of the coils, in combination with suitable fastening devices for holding said plug against displacement by revolution of the armature."

400,978. Electric Heating Apparatus. Henry E. Watts, [illegible]

The invention consists of electric cores surrounding magnetic cores and metallic plates placed in inductive relation with said cores. When alternating currents flow in the coils, the metallic plates, by reason of the induced alternating currents generated therein, are [illegible] degree of temperature. This is utilized in a manner best suited to the purpose for [illegible]

[illegible]80. Standard Tangent Galvanometer. Edward [illegible]

The invention relates to that class of galvanometers [illegible]ich the tangent of the angle of deflection of the magnetic needle is proportional to the strength of cur- [illegible] of the instrument. [illegible]

[illegible] electrical instrument [illegible]rating index mirror, a curved surface [illegible] with the [illegible] said sur- [illegible] of said mir- [illegible]

[illegible] instrument [illegible] surface [illegible] with the [illegible] mirror, the [illegible] center drawn perpendicular to [illegible]

[illegible], England. [illegible]

[illegible] M. Tin- [illegible]

401,014. Insulating and Coating Compound. Affonso de Figaniere, Philadelphia, Pa.

The claim reads: "The hard, fusible, insulating and coating composition, consisting of pulverized coal, lime and coal-tar pitch."

401,035. Electrical Night Signaling Apparatus. Emil Kaselowsky, Berlin, Germany.

401,041. Electro-Medical Apparatus. John J. Lewin, San Francisco, Cal. Claim 1 reads:

"In an electro-medical apparatus, the core composed of fine parallel wires extending horizontally and having the ends upturned, in combination with the insulated wire wound around said core from end to end and upon the upturned portion."

401,059. Galvanic Battery. James H. Phalan, New Haven, Conn.

401,065. Electric Winding for Torsion Pendulum Clocks. Heinrich Rabe, Hanau, Germany.

401,067. Circuit Connecting Device. John C. Reilly, Brooklyn, N. Y.

401,085. Lightning Arrester. Elihu Thomson, Lynn, Mass.

401,095. Lightning Conductor for Wire Fences. Fremont E. Wood, Yucca, Ariz.

401,112. Wire Cable. Telford C. Batchelor, 8 Barons Court Road, West Kensington, County of Middlesex, and Arthur Latch, Biddick Hall, South Shields, County of Durham, England.

401,120. Manufacture of Incandescent Lamp Filaments. Turner D. Bottome, Newark, N. J.

Claims 1 and 2 are given:

"1. The process of manufacturing filaments, consisting in saturating a carbon filament with a tungsten compound and reducing such compound to metal tungsten.

"2. An incandescent filament composed of metallic tungsten and carbon in varying proportions."

401,152. Armature for Electro Magnets. John Geary, Philadelphia, Pa.

The invention consists in constructing an armature of two sections of the same degree of conductivity—a light one hinged or otherwise secured in the face of a heavier section. The lighter section, being in the field of attraction of a single magnet and more sensitive than the heavier one, is drawn to a point very near to the magnet poles, where the attraction is sufficiently great to cause the lighter section to draw the heavier section into the field and into contact with said poles with very great force, allowing of the movement of said heavier section to a very much greater extent than with the ordinary solid armature.

401,153. Electric Gas-Lighting Burner. John Geary.

401,154. Tube or Conduit. George H. Gillette and King C. Gillette, New York, N. Y.

401,155. Conduit for Electrical Conductors. George H. Gillette and King C. Gillette, New York, N. Y.

The second claim reads:

"A conduit comprising a series of non-conducting material, as glass, provided with tapering longitudinal openings, said sections being arranged and secured one after another with the larger ends of the openings in the succeeding sections adjacent to the smaller ends of the openings in the immediate preceding sections."

401,156. Static Induction Machine. Hermann Glaser, Vienna, Austro-Hungary.

The invention relates to an improved electric machine; and it consists, chiefly, in that the electric generator is composed of two hollow drums of idio-electric material, of which the smaller is arranged air-tight within the other and both arranged to rotate around a common axle, but in opposite directions.

401,161. Internal Combustion Thermo Dynamic Motor. James Hargraves, Farnworth, County of Lancaster, England.

401,191. Electric Meter. Albert H. Manwaren, Philadelphia, Pa.

401,200. Electric Valve Controller. William E. Norris, Waterbury, Conn.

401,207. Combined Mechanical and Electro-Magnetic Motor. Charles A. Randall, London, England.

401,221. Electric Railway. Sidney H. Short, Denver, Colo.

The object of the invention is to provide, in connection with the conductors of a series electric road, means by which the main and return wires may be placed in parallel with one terminal of the generator and the track in connection with the other terminal, with electrical connections from the rails of the tracks to the motor and from the motor to the conductors of the series system, whereby the cars during a break in the circuit may be run in multiple arc upon either side of the break.

401,225. Apparatus for Laying Electrical Conductors. Walter F. Smith, Philadelphia, Pa.

401,226. Electric Meter. Walter F. Smith, Philadelphia, Pa.

401,227. Mechanical Telephone. George Thomas, New York, N. Y.

[illegible] Regulator for Dynamo Electric Machines. Charles J. Van Depoele, Chicago, Ill.

[illegible] "The combination of a generator [illegible] field of force, one [illegible] circuit, the other being in [illegible] current to the field magnet [illegible] generator and a motor for automatically [illegible] of both armatures [illegible] said commutator [illegible] diminish the output [illegible] field magnet circuit, according to the rise or fall of potential in the main circuit, and prevent sparking in the brushes of the main armature."

401,231. Reciprocating Electric Engine System. Chas. J. Van Depoele, Lynn, Mass.

The invention relates to improvements in reciprocating electric engines for the operation of mining drills and the like, and for other purposes where a reciprocating motor is required.

The first claim follows: "An electro-magnetic reciprocating engine system, comprising a generator adapted to produce independent current phases, a reciprocating electro-magnetic engine having two or more motor-coils, and independent circuits extending between the coil or coils and the generator."

401,244. Splicing Device. John C. Basel, Galveston, Tex.

401,255. System of Transmitting and Distributing Electricity. Stanley C. C. Currie, Philadelphia, Pa.

The last claim is appended: "5. The method of distributing and transmitting electricity, consisting in producing two or more currents of low electromotive force, transferring such currents at intervals of time to reservoirs disconnected from the generator circuits, again transferring such currents to reservoirs connected with a main line and combining the said currents to form a current of high electromotive force, then conveying said current of high electromotive force over the main line and dividing it into currents of lower electromotive force, then transferring such currents to reservoirs connected to the main line, and finally transferring said currents at intervals to distributing reservoirs disconnected from the main line."

401,270. Switch or Circuit-Changer. William W. Griscom, Haverford College, Pa.

The second claim reads: "The combination, in a switch or circuit-changer, of two pieces of conducting material respectively pivoted at points midway between their extremities to reciprocating bearings and normally held in contact at two points by spring-pressure, with a plug or wedge consisting of two strips or conductors insulated from each other and adapted to successively separate said two contact-points by a continuous advance movement."

401,289. Secondary Battery. William Main, Brooklyn, N. Y.

401,290. Secondary Battery. William Main, Brooklyn, N. Y.

Of the thirty-eight claims we give the first and seventh:

"1. In a laminated secondary battery element, two or more layers of material active in the battery, having between them a layer of carbonized cloth or other fabric.

"7. In a battery cell, a set of negative elements, a set of positive elements, and a rack formed of vertical plates of insulating material connected by rods for supporting the elements; also of insulating material adapted to receive the set of negative elements on one side and the set of positive elements on the other side thereof."

401,291. Process of Preparing Electrodes for Secondary Batteries. William Main, Brooklyn, N. Y.

The first claim is given: "The process of preparing a secondary battery pole-piece, which consists in subjecting a layer of granulated zinc to the action of an electrical current in an electrolyte and in the presence of mercury, thus causing a spongy formation of the zinc and mercury upon the granules of said layer."

401,296. Electrical Call Bell. Joseph G. Noyes, New York, N. Y.

401,304. Device for Supporting and Operating Electric Lights. Charles W. Russell and John I. Drake, Providence, R. I.

401,317. Dynamo or Magneto Electric Machine. Edward Weston, Newark, N. J.

For the usual wire coils in each division of the armature are substituted diametrically oppositely-placed insulated conducting bars or strips of considerable area in cross-section combined with insulated conducting disks, or plates, at the ends of the core, which serve to connect the bars. The bars and disks, or plates, with which the armature is thus provided being connected one with the other.

Second and third claims: "2. An armature coil composed of longitudinal bars or strips, combined with cross-connecting disks which at one end of the armature connect the two bars of one set and at the other end of the armature connect the terminal bar of one set with the initial bar of the next succeeding set, the latter disks being connected up with the commutator.

"3. In a revolving armature, a conducting coil whose longitudinal portions are united at the end or ends of the armature by a disk or plate connection, substantially as and for the purposes hereinbefore set forth."

401,318. Dynamo Electric Machine. Edward Weston, Newark, N. J.

The object of the invention is to facilitate the circulation of air through the armatures, whereby the core and the coils, or conductors, wound upon the core are prevented from heating. To effect this purpose the conductors or coils are applied to the core in such manner that the former will be separated from the core, so as to leave air spaces entirely around them.

401,322. Apparatus for the Application of Electricity to Propel Vehicles. Frank Wynne, Westminster, County of Middlesex, England.

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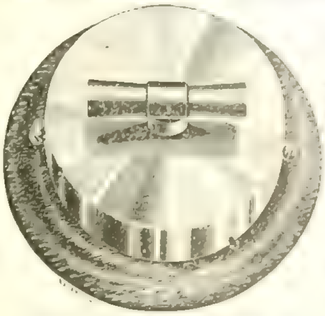

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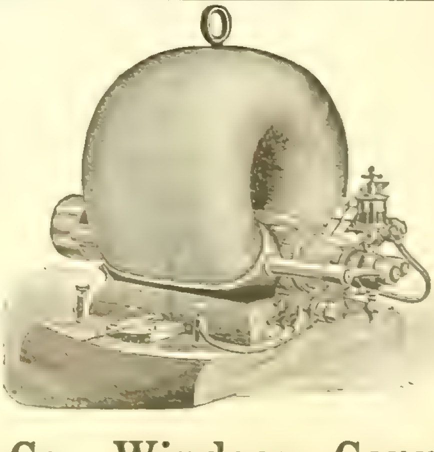

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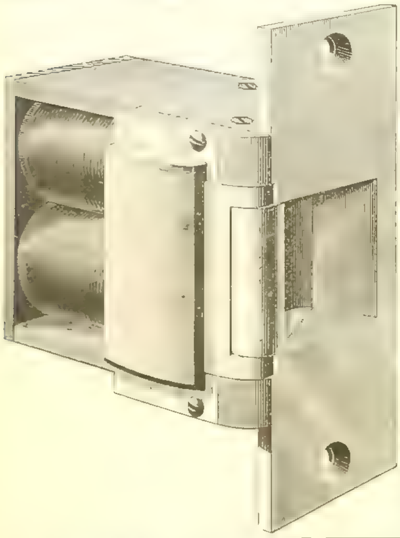

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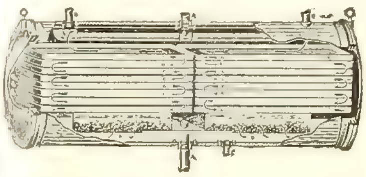

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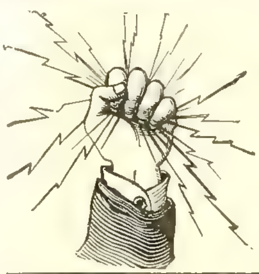

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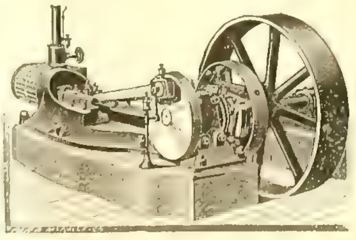

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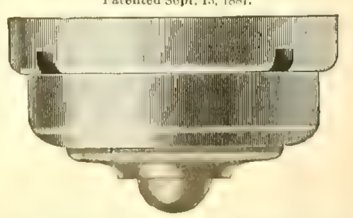

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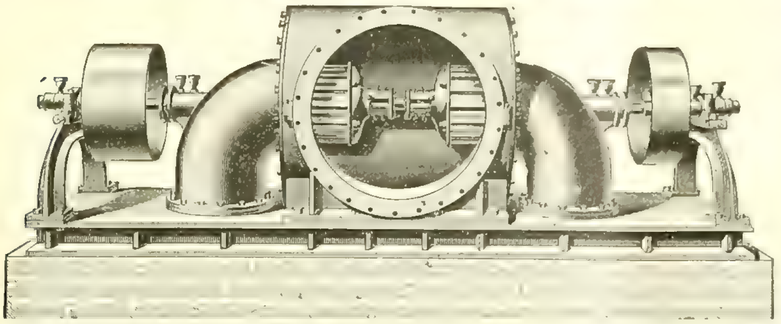

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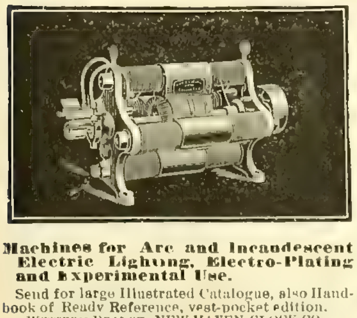

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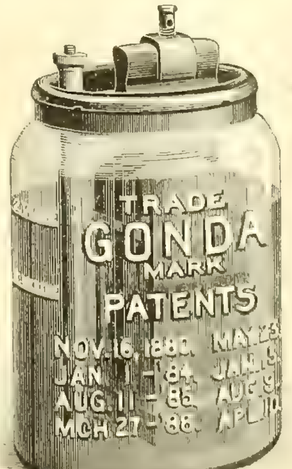

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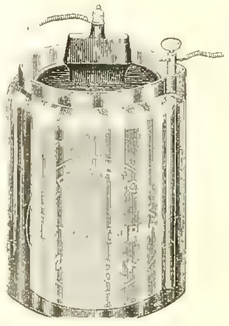

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DEAR SIR:——

We beg to call your attention to the present state of our system of Traction on Fourth and Madison Avenues in this city.

The last car which we put into actual passenger service (Car No 7), and which is the standard type of car that we have finally adopted, is making five round trips per day between Eighty-sixth Street and Madison Avenue and the Postoffice, or 57½ miles daily. This is a car day's work on that line.

During the past forty (40) days its receipts in cash have been $998.10, exclusive of 998 transfers, for which it gets no credit; this is at the rate per annum of ***$9,106.75***

The average earnings of horse cars on the same line are ***6,387.50***

Difference in favor of the Julien System ***$2,719.25***

Deducting from gross earnings $4.00 a day for driver and conductor, and $3.60 per day for motive power, wear and tear, and royalty, would leave, per annum ***6,332.75***

Further deducting 6 per cent. interest on $6,000 (cost of the car with battery-racks, stationary motors, switches, etc.), ... ***360.00***

Leaves net earnings ***$5,972.75***

These net earnings will more than pay the entire cost of the car and its equipment at the end of the first year.

During the time the car has been in operation neither the batteries nor the motors have required attention nor the expenditure of one dollar for repairs or renewals. Even the brushes have not been changed, nor do they show any wear.

Car No. 1 on Fourth Avenue line commenced service on September 3d ultimo, and on April 8th her batteries were examined for the first time. They had not in this period been lifted from the cells to be cleaned or inspected. They were found to be in as good condition as when they were put in service—not a single plate in the whole battery showing any wear, injury or depreciation.

At one time it was thought that the handling of the batteries in our system of traction would be a serious obstacle, but this Company has now a battery shifting device whereby, in the length of a car body and on either side of the pit over which the car stands in the station, sufficient batteries are stored and manipulated to do the work of one hundred and thirty-five horses. The racks which contain the batteries and the hoists, which are run by two small stationary motors, do not, in all, cover as many cubic feet as two sixteen-foot cars. By aid of this device the batteries are changed in less than three minutes. In actual time, less than five minutes are required to inspect the car thoroughly, and change the battery.

An additional and important feature of this system is that a street railway need no longer have its own generating machinery, as must be the case with cables, over-head wires, and conduit systems. In every town and city where there is a central lighting station, power for charging the batteries may be purchased for about two cents per horse-power. So that the plant of our system will be reduced to the simple devices of one battery-rack, as above described, for each set of fifteen cars and switch-boards for governing the distribution of the current. Can anything be more simple?

The cost of motive power for a car day of sixty miles we estimate at $3.10. By motive power, we mean cost of energy at two cents per horse-power, and $700 per annum for maintenance of batteries and motor. These figures are the result of our present experience. To those who may think two cents per horse-power is a low estimate, we may say that we have offers from electric companies to furnish power at that figure. Indeed, it is furnished for less in some cases.

We guarantee our cars to do efficient service, and we will agree to maintain motors and batteries for a fixed annual sum.

Our new cars, thirty of which are now under construction by the Stephenson Company, will weigh but a fraction over six tons, or, in other words, but little more than the cars of the overhead system.

The following is a statement of mileage, passengers carried, etc.:

Record of Julien Storage Battery Cars on New York & Harlem Railroad City Lines, New York City, to March 31, 1889, inclusive.

Number of Car.	Miles Run.	Passengers Carried.
1	3,057½	27,076
2	1,276½	11,097
3	1,922½	16,040
7	1,875½	16,782

RECORD OF CAR NO. 7.

This new car was put into regular service on February 23, 1889, and has since been run on a special schedule of 57½ miles per diem, exclusive of Sundays.

Date.	Passengers.	Transfers.	Mileage.	Trips.	Cash.	Remarks.
April 1	445	26	57½	5	$22 25	Rain
" 2	520	34	57½	5	26 00	Fair
" 3	537	26	57½	5	26 85	"
" 4	517	13	57½	5	25 85	"
" 5	570	8	57½	5	28 50	"
" 6	554	48	57½	5	27 70	"
" 7	Sunday					
" 8	536	26	57½	5	26 80	"
" 9	529	26	57½	5	26 45	"
" 10	561	13	57½	5	28 05	"
" 11	594	33	57½	5	29 70	"
" 12	533	15	57½	5	26 65	Rain

THE JULIEN ELECTRIC TRACTION CO.,

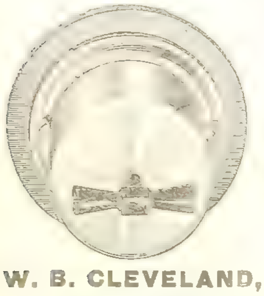
120 BROADWAY, - - - NEW YORK.

Forest City Electric Works,

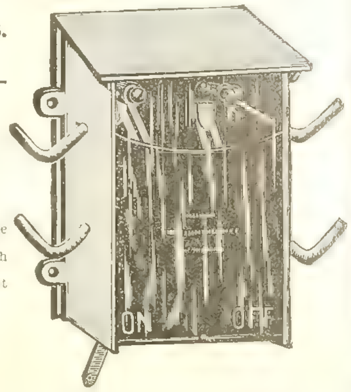
Manufacturers of CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.



Correspondence Solicited with Electric Light Companies.



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14 YEARS.

FOR PAMPHLETS AND PARTICULARS ADDRESS

1873–1887.

NO EXPERIMENT.

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"SHOULD NOT KNOW HOW TO GET ALONG WITHOUT IT."

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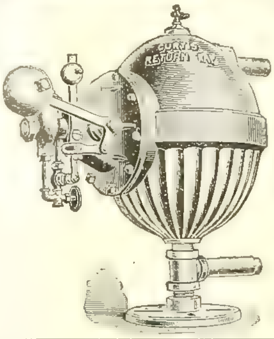

THE CURTIS

PATENT RETURN STEAM TRAP.

It is noiseless, positive, rapid, will return all condensation back into the boiler, and works equally well in connection with reduced pressure or exhaust steam, also when the return is below the water line of the boiler.

THE CURTIS REGULATOR COMPANY,
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GENERAL AGENCIES.

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BY F. B. BADT.

Price, Postage Prepaid to any address in the United States or Canada, $1.00.

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ARTISTIC ELECTRIC LIGHT

AND

COMBINATION FIXTURES

OF ALL KINDS.

BERGMANN & COMPANY, NEW YORK,

Call the attention of the **Public** and the **Managers of Electric Light Companies** to the fact that they have added another large and **Well-Equipped Factory Building** to their former premises. This addition has been necessitated by the unexampled success and favor with which their **Work and Prices of Electric Light** and **Combination Fixtures** have met; and in soliciting the favor of an opportunity to bid on all kinds and classes of such goods, both for **Public** and **Private Use**, they confidently refer to their past customers, and solicit the closest scrutiny of the **Artistic Excellence, Mechanical Execution and Low Prices** of their **Samples** and **Designs** which will be furnished on application to any one desiring **Electric Light and Combination Fixtures.**

Being the **Pioneers** in the business of manufacturing both **Fixtures** and **Apparatus** for **Electric Lighting, Bergmann & Co.** have at once the **Longest** and most **Varied Experience** in all the requirements pertaining to such manufacture, and the most **Complete Facilities** for securing that perfection of the **Electrical Details** of the same, which is necessary to **Fill** these **Requirements** in such a way as to **Prevent** the **Continual Annoyance** and **Danger Consequent** to the **Users of Electric Light** and **Combination Fixtures** on any variation therefrom.

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T. W WILMARTH & CO., 227 STATE ST., CHICAGO, ILL.,
Agents for our Fixtures in the Northwest.

WHO IS

The Pioneer in the Development of the Incandescent Electric Light System?

FACTS OF THE PRESENT CONTROVERSY.

THE NATIONAL ELECTRIC MANUF'G CO.

HOLDS THE KEY TO THE SITUATION.

BEWARE OF IMPOSTORS.

"SUUM CUIQUE"

TO USERS OF ELECTRIC LIGHT APPARATUS:

The Edison and Sawyer-Man Electric Light Companies have recently deluged the country with circular letters and bombastic advertisements, setting forth that they have patents, which cover the fundamental principles of electric lighting; and that their patents have been sustained in the Supreme Court giving the exclusive right to manufacture and operate incandescent lamps. Nothing could be more misleading than such statements.

Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simple a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

This company takes the position: First, to defend the users of its apparatus against loss accruing from its use; second, to vigorously and determinedly prosecute Walter K. Freeman's claims for patents covering these inventions.

Our apparatus is of the highest efficiency—mechanically and electrically. We are prepared to guarantee its operation and defend our customers.

We are in this business on a business basis, for a manufacturer's profit; having all modern facilities for the production of first class apparatus. We solicit the patronage of electric light users, believing we can furnish the best.

OUR Dynamos, Lamps, and Converters are guaranteed to be the most perfect, mechanically and electrically, in the world. Our prices are low. We protect our purchasers as no other company **CAN.**

GET THE BEST. *Representatives wanted in every State in the Union.* **GET THE CHEAPEST.**

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After careful IMPROVEMENTS in construction, has now been found to be THOROUGHLY RELIABLE and DURABLE, and is, owing to its design, PECULIARLY ADAPTED to many uses in which other types of batteries have failed.

SPECIALLY ADAPTED TO

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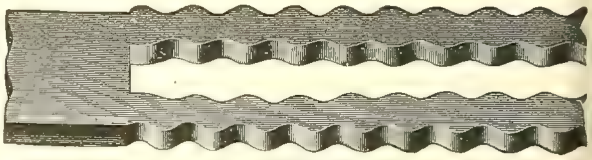

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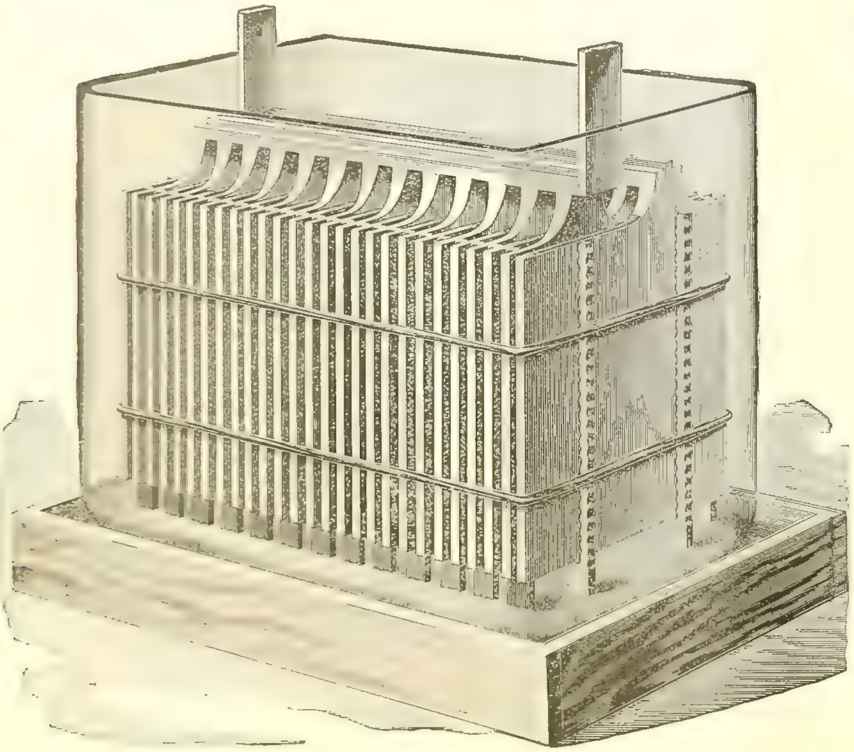

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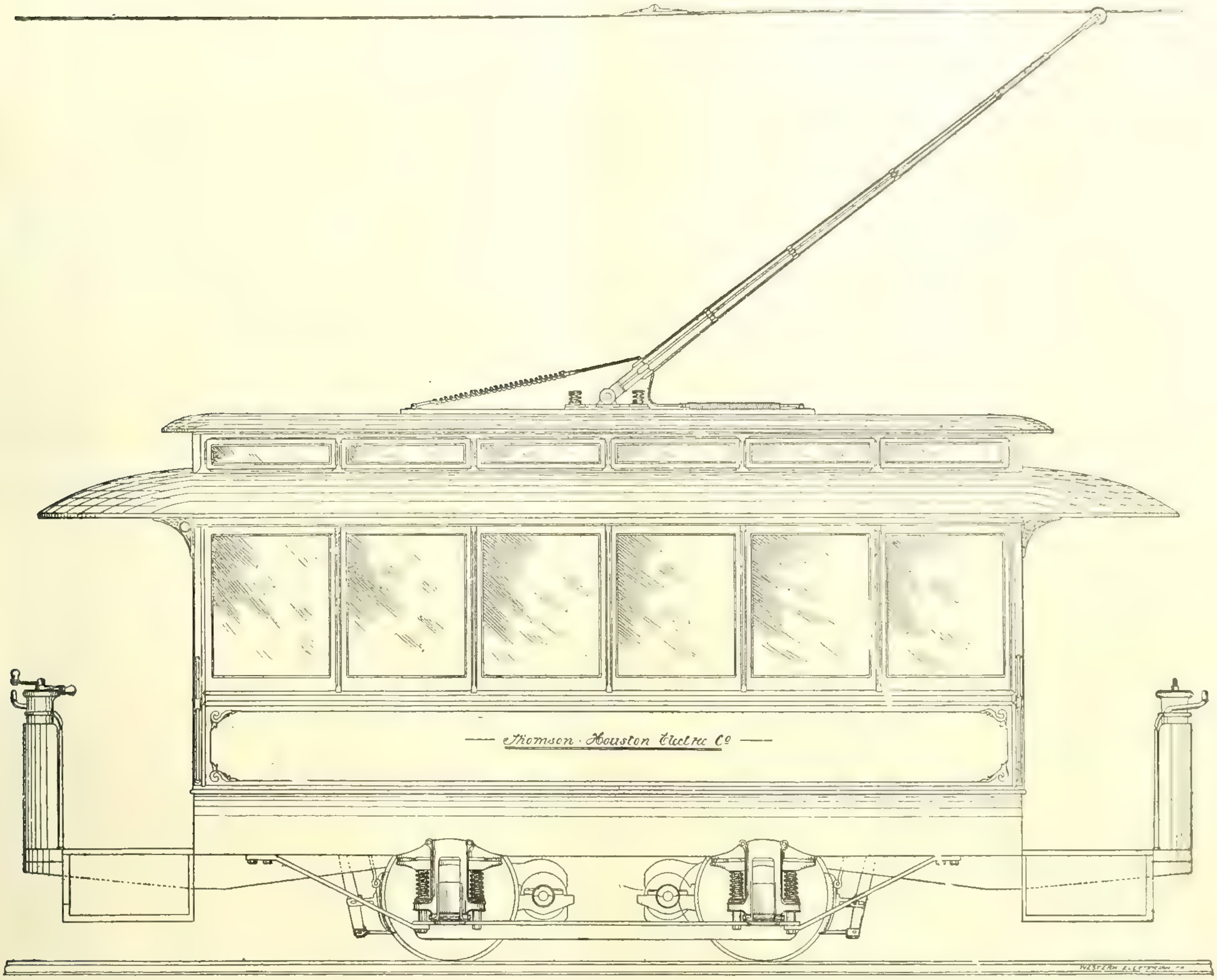

Twenty-six Roads in Daily Operation, and Sixteen Now in Process of Construction Under the Thomson-Houston Patents.

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The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

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No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Thomson-Houston patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

MOTORS & ELECTRICAL EQUIPMENTS FURNISHED FOR MINING & OTHER SPECIAL WORK.

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Standard Testing Set.

WHEATSTONE BRIDGE AND
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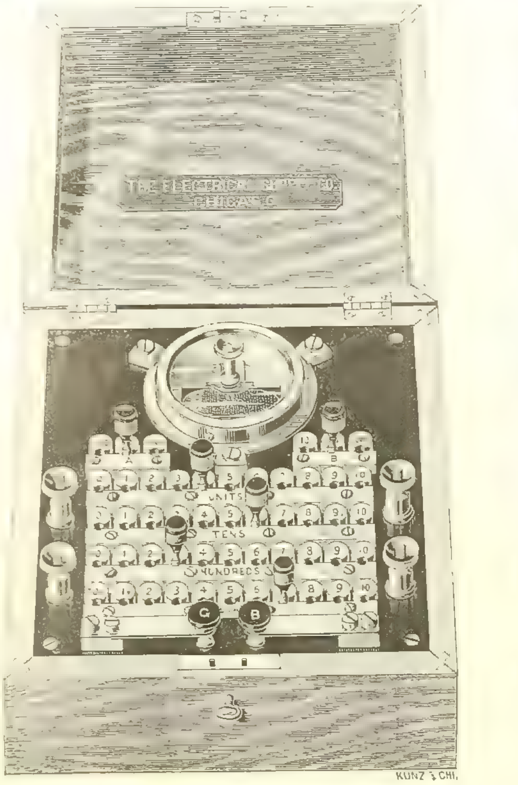

Every station should have one. See our Electric Light Catalogue—page 134—for full description.

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You will be interested and repaid.

PERFECT PROTECTION
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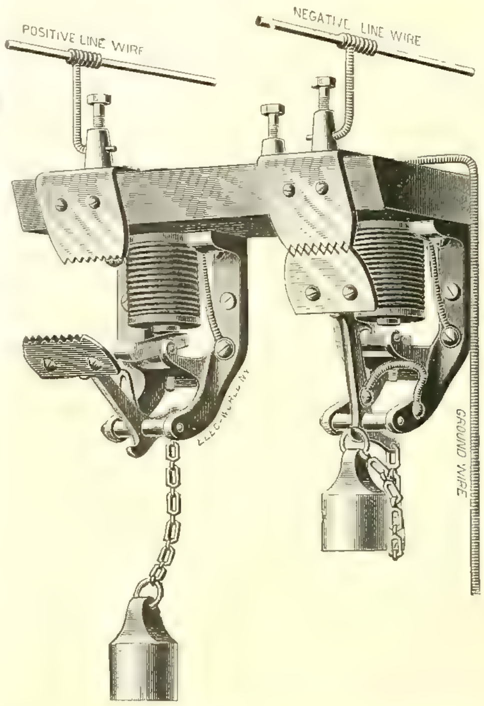

IS YOUR DYNAMO PROTECTED?

If not—we would remind you that "delays are dangerous"—see page 61 our Electric Light Catalogue, and telegraph us to forward by express as many Lightning Arresters as you find necessary for your station. Storms are expected.

P. and B.

"A Most Excellent Insulation."

P. and B. WEATHERPROOF.

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Write us for full information. Facts are more substantial than mere words.

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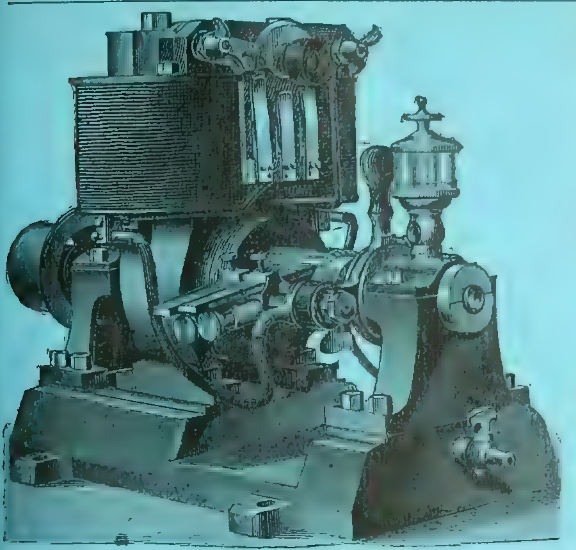

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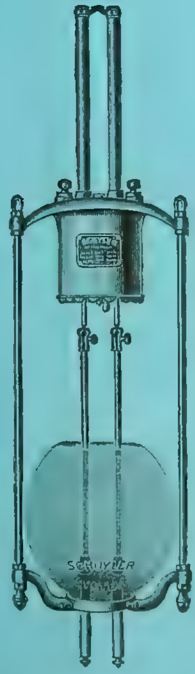

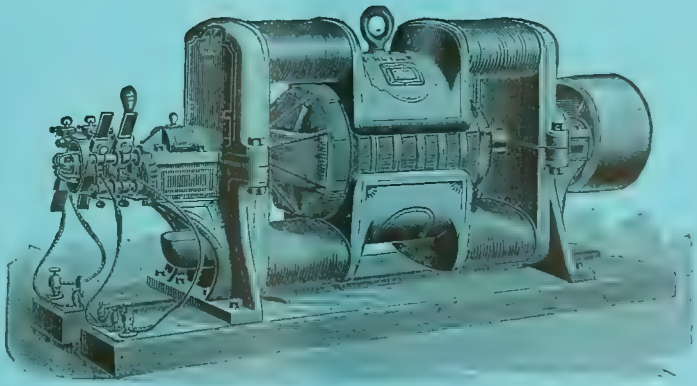

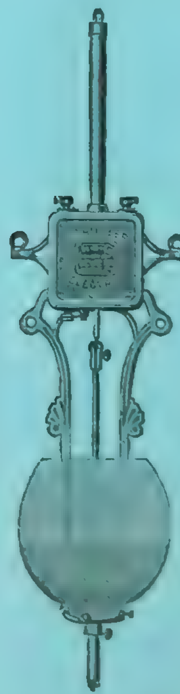

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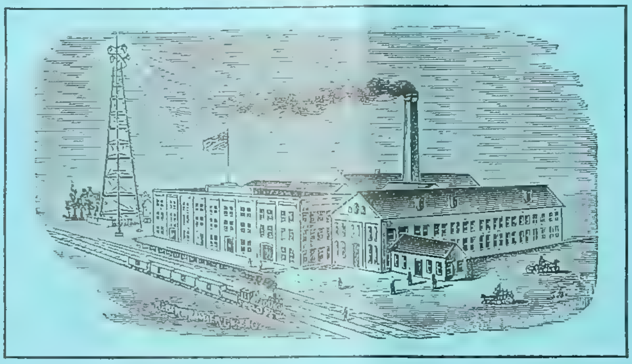

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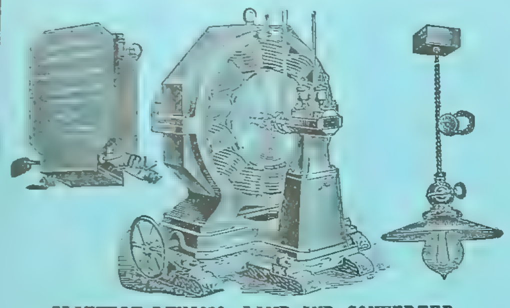

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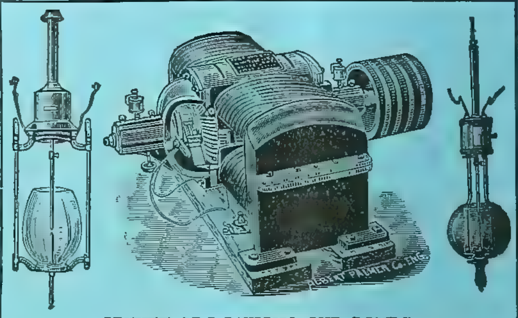

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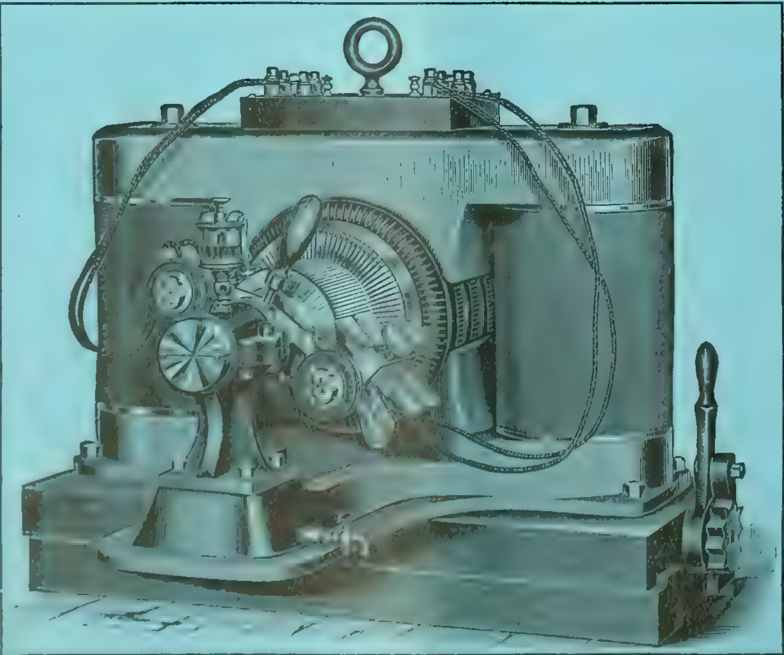

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HIGH OR LOW TENSION,
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This is the DUST-PROOF WASHER

Buy no Bells WITHOUT IT.

HAZAZER & STANLEY, ELECTRICAL House Furnishings

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Oldest and Largest Manufacturers in the United States of

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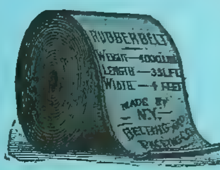

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RUBBER BELTING, PACKING & HOSE.

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With Smooth Metallic Rubber surface for use on Dynamos and swift running machines.

VULCANITE EMERY WHEELS, RUBBER MATS, MATTING AND STAIR TREADS.

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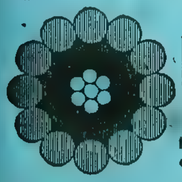

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The acknowledged Standard for durable and high insulation. Its merits proved by a record of over quarter of a century. Adapted to all electrical purposes.

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All Sizes *Lead Encased Wires.*

Aerial Use, Subterranean Use, Submarine Use Concealed Wiring in all Locations.

E. B. McCLEES, General Manager, 16 Dey St., NEW YORK.

THE ASHTON VALVE CO.

The Ashton Noiseless Blow Back

Locomotive Safety Valve, The Ashton Lock Safety Valve, The Ashton Water Relief Valve.

THE ASHTON VALVES Have a wide reputation as being the most perfect of their kind.

THEIR SAFETY VALVES Give perfect security against boiler explosion, whether Steamboat, Locomotive or Stationary.

THEIR WATER RELIEF VALVES For Pumps, Stand Pipes, and Steam Fire Engines are the best now in the market.

Simple in construction, Automatic in action, Perfectly Controlling the Pressure of the hose at whatever speed the eng ne or pump is working.

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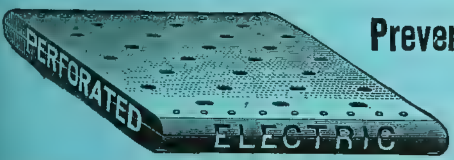

Pat. May 24, 1888.

Prevents Air Cushions.

GUARANTEED FOR

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Chas. A. Schieren & Co., (Mfrs.)

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OAK TANNED LEATHER BELTING AND LACE LEATHER.

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ANSONIA BRASS & COPPER COMPANY,

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Fire-Proof and Weather-Proof

ELECTRIC LIGHT LINE WIRE.

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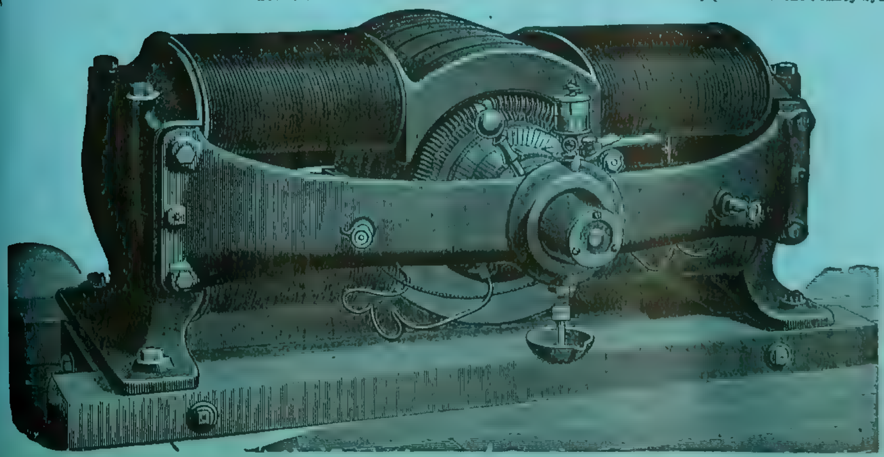

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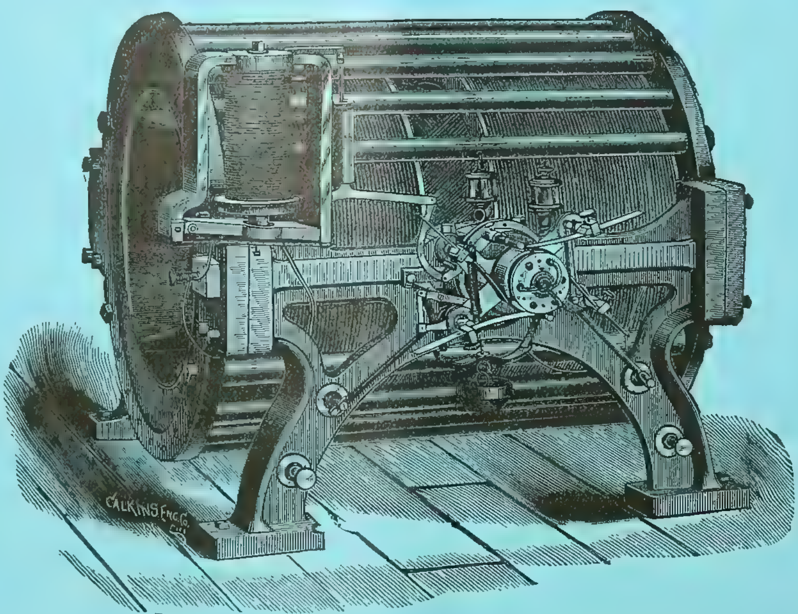

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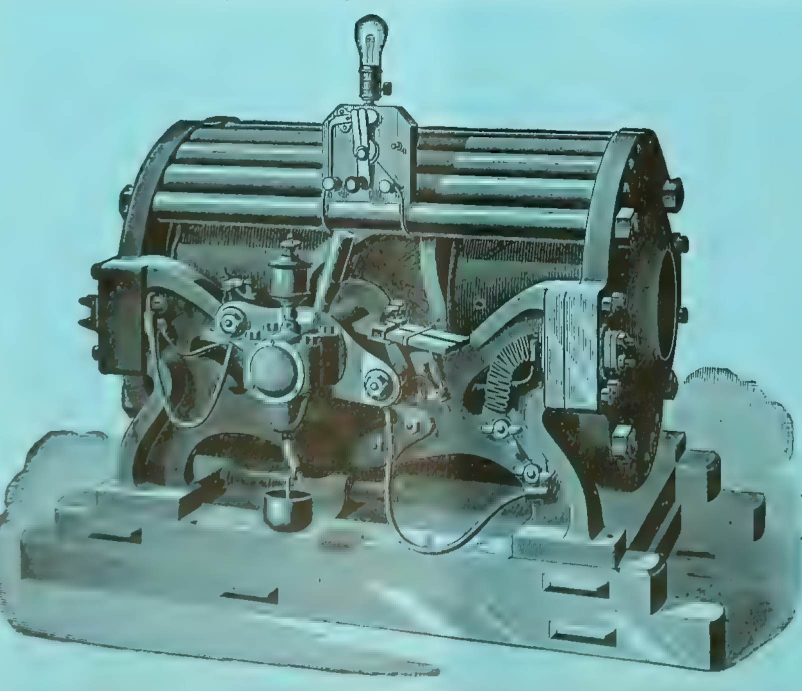

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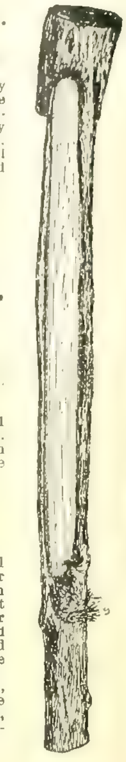

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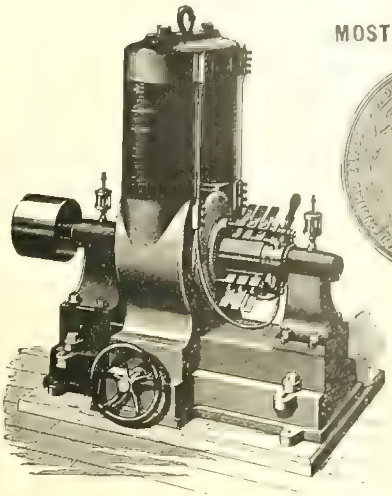

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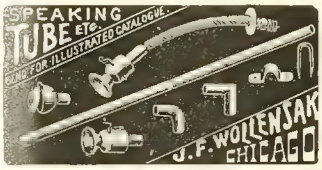

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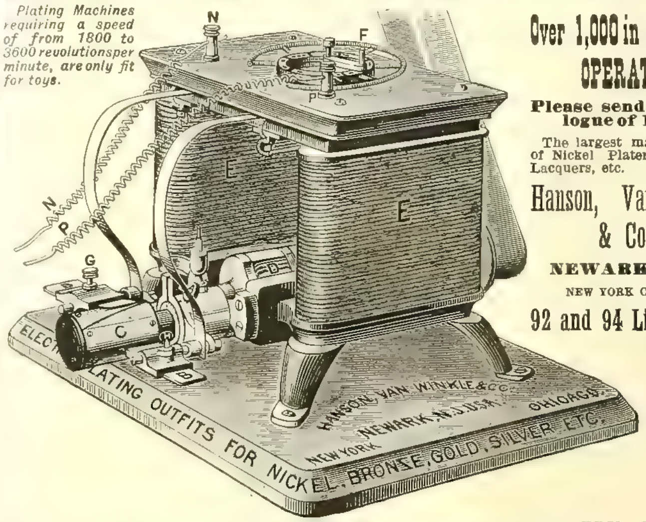

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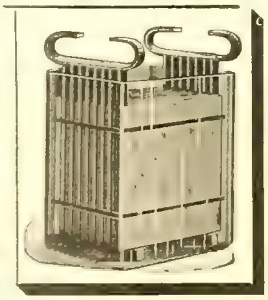

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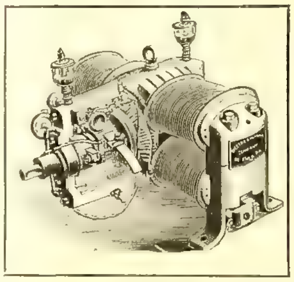

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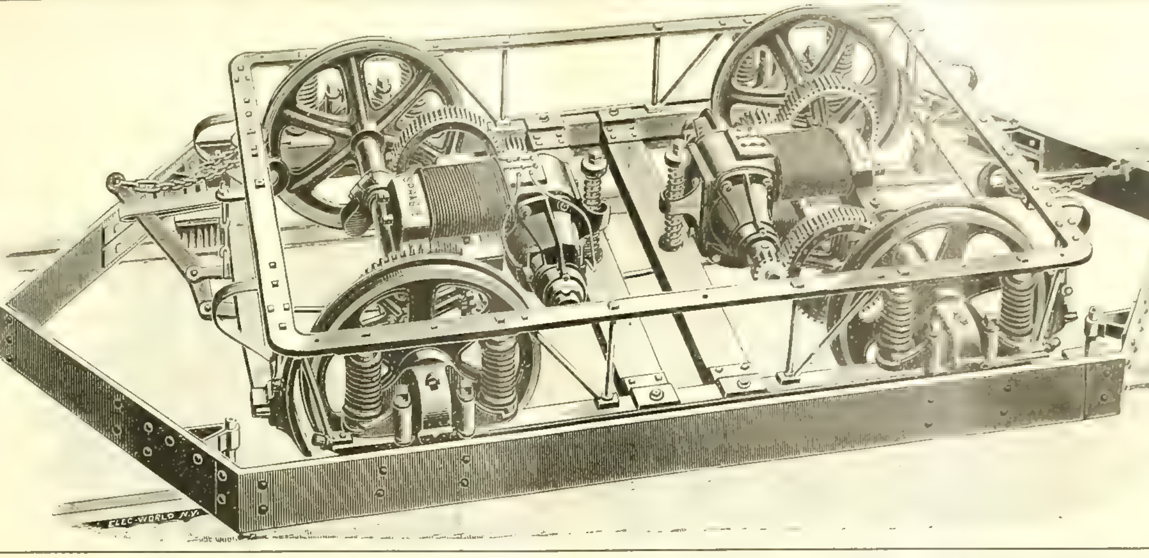

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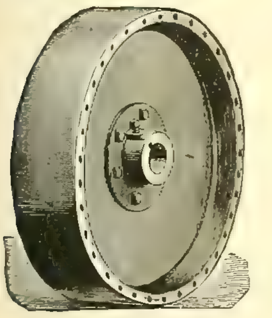

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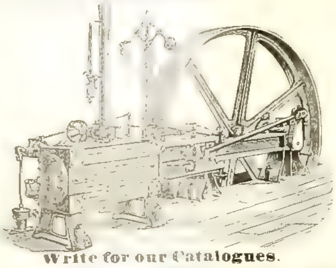

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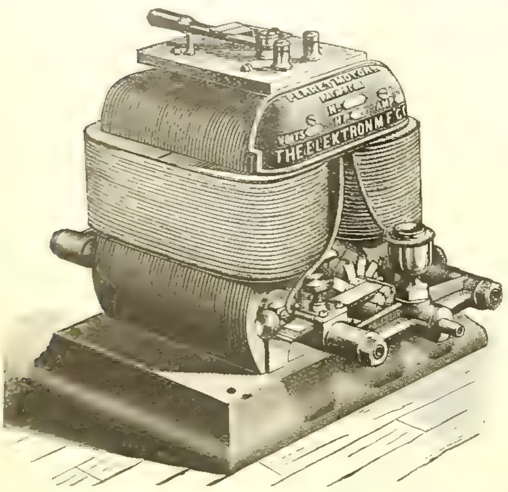

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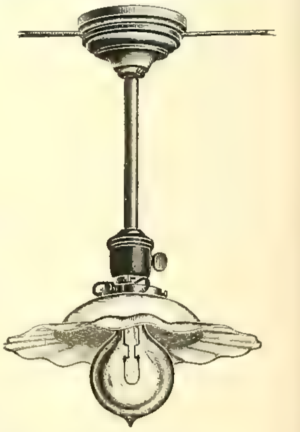

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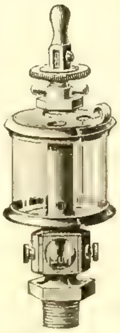

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Fig. 1 Shows oil dropping while machinery runs.

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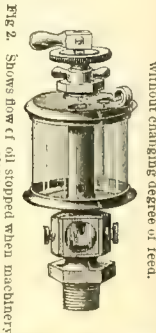

Fig 2. Shows flow of oil stopped when machinery stops.

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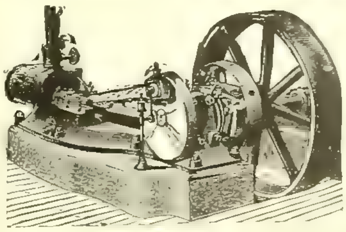

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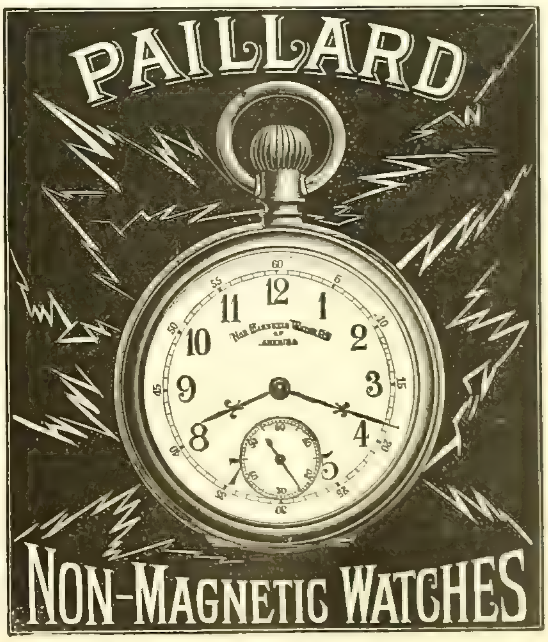

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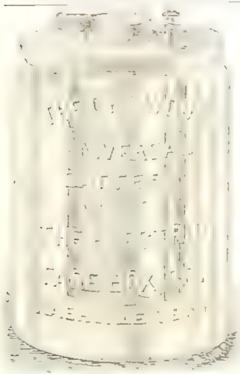

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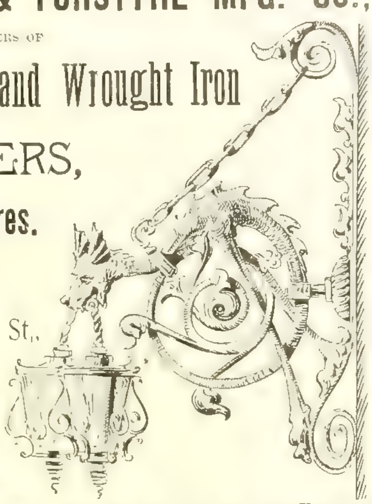

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EDISON TRIUMPHANT!

His Patents Sustained by the United States Supreme Court.

THE EDISON ELECTRIC LIGHT CO.

Takes pleasure in announcing to its patrons and the general public that the decision of the Supreme Court of the United States, filed on the 21st ult., in the case of the Bate Refrigerator Company, is in fact a decision

SUSTAINING THE EDISON PATENTS

In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

Thus the QUESTION OF LAW having now been settled by the Supreme Court of the United States, and the QUESTION OF FACT by the highest experts of the world, this company now notifies the Public of its intention to call a halt and demand a reckoning for the trespass and abuse of its rights in

INCANDESCENT ELECTRIC LIGHTING.

EDISON ELECTRIC LIGHT CO.,

16 AND 18 BROAD ST., NEW YORK. *By EDWARD H. JOHNSON, President.*

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WESTINGHOUSE ELECTRIC CO.,

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THE PIONEERS IN INCANDESCENT LIGHTING

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COMPLETE CENTRAL STATION OUTFITS.

Alternating Current Apparatus,

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150 CENTRAL STATIONS IN OPERATION. 150

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Arc and Incandescent Apparatus

—FOR—

ISOLATED LIGHTING.

Efficient Apparatus!

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SUPPLIES FOR ELECTRIC WORK.

ELECTRIC AND COMBINATION FIXTURES.

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BADT TESTING SET.

The illustration shows this new testing set, designed specially for

LINE MEN,

DYNAMO TENDERS

AND

BELL HANGERS.

It Consists of a Highly Polished Cherry Box,

containing a small dry

GALVANIC CELL,

DETECTOR GALVANOMETER

Of 500 Ohms' Resistance,

CONTACT KEY AND TWO BINDING POSTS.

Tae external dimensions of the box are 5 3-4x3 3-4x2 7-8.

Total weight, one pound and fifteen ounces.

The Galvanometer, Key and Binding Posts are mounted on a sliding Shelf, beneath which is the dry cell. By opening the end of the box, the shelf can be drawn out for inspection or repairs. The standard resistance of the coil is 500 ohms, but we will make them of any resistance to order. One ceil will deflect the needle a few degrees, even through a resistance of 15,000 ohms.

PRICE FOR THE SET COMPLETE, $15.00.

KERITE WIRE.

We are sole agents for the sale of Kerite Wire for the Western States. This wire has been tested by years of actual service and stands at the head of goods of like character.

WESTERN ELECTRIC CO., - CHICACO.

Western Electrician

EVERY SATURDAY.

Vol. IV. CHICAGO, APRIL 27, 1889. No. 17

The Western Electric Incandescent Lighting System.

The Western Electric company of Chicago has introduced recently an incandescent lighting system of its own manufacture and design, which possesses new and interesting features. The type of field magnet frame utilized in its arc system is not used for the incandescent dynamo, but a simpler form, and one better adapted to this class of work, has been adopted. Figs. 1 and 2 illustrate the complete incandescent dynamo, while Fig. 3 shows the field magnet and pole pieces. The whole iron base is cast in one piece. The cores of the field magnets are made of soft iron, and pole pieces are cast upon the upper ends of the cores. The lower ends

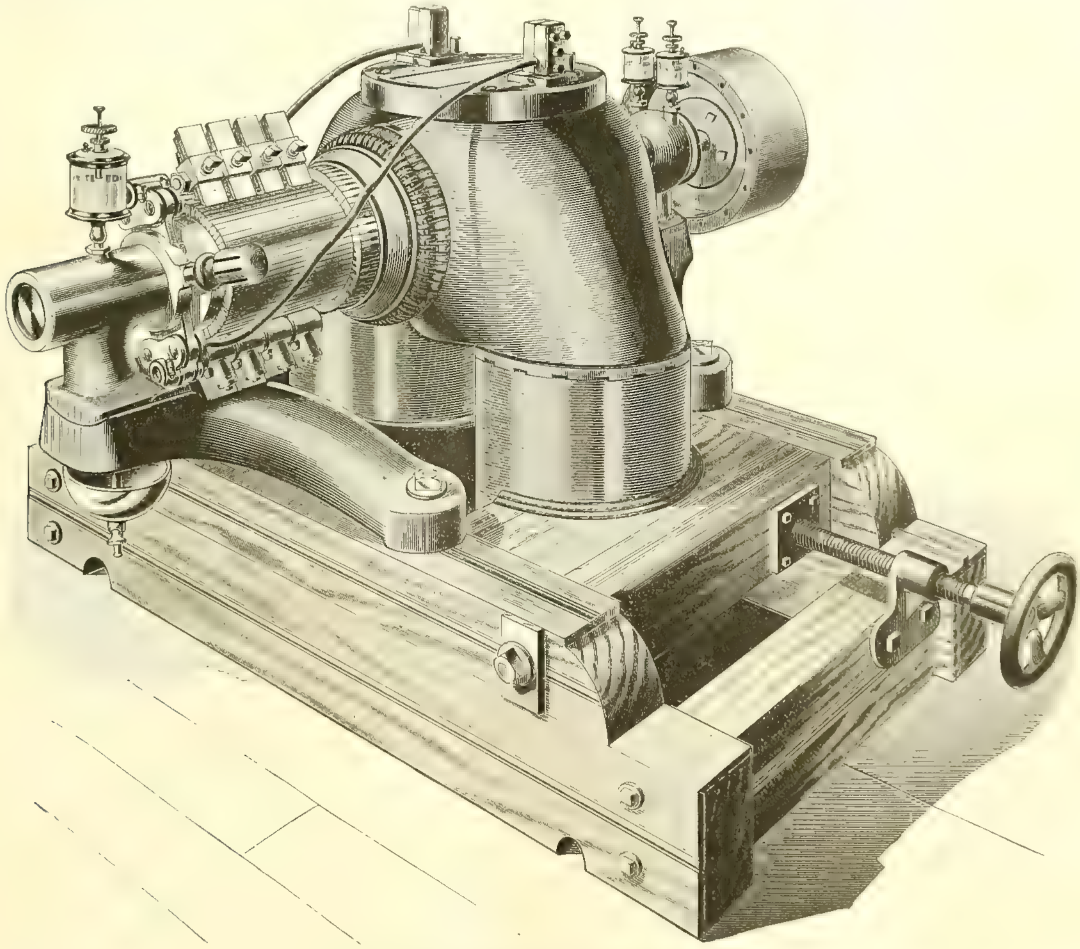


FIG. 1. THE WESTERN ELECTRIC INCANDESCENT SYSTEM.

of the cores are bolted to the cast iron base. There are, therefore, only two magnetic joints in the whole system. The field magnet coils are connected, shunting the armature. The automatic regulation thus secured is practically perfect. Any number of lamps may be cut in or out without visibly affecting the candle power or brilliancy of the lamps throughout the system. The armature is of the drum type, and is wound in a very simple and peculiar way, avoiding all joints in the wires but two. The electrical and commercial efficiency of the dynamo is very high, while in its mechanical construction it is above the average. There is a self-adjusting bearing on the pulley side.

The peculiar form of the cast iron base results in bringing the armature shaft at a convenient height from the floor, but not so high as is usually the case in dynamos having this type of field magnet, while at the same time it permits the use of the sliding carriage for adjusting belt tension without raising the dynamo or rendering it unstable. On the top of the pole pieces is secured a hard-wood board, on which the field and main binding posts are mounted.

The rheostat, Fig. 4, is non-combustible. It consists of a cast-iron frame provided with porcelain insulators, to which the German silver wire coils are attached. The front of the rheostat, too, is covered with glass, preventing dirt and dust from entering the box, and at the same time allowing ready inspection.

Figs. 5 and 6 represent the voltmeter and ammeter. The instruments are dead beat, and may be left in the circuit permanently without overheating.

The lightning arrester, Fig. 7, is very simple, and requires no automatic cut outs or safety strips for the operation of short circuits. The jaws of the lightning arrester are made of carbon plates. If the dynamo current should follow a discharge of atmospheric electricity an arc may be set up, but this will burn away some of the carbon points, and thus free the dynamo of the short circuit. Such a carbon lightning arrester can, of course, only be used for low tension dynamos.

Fig. 8 represents a main switch, and Fig. 9 a [illegible] show the ceiling cut outs. Fig. 12 illustrat[illegible] branch [illegible]. These [illegible] mounted on wood or porcelain.

The multiple safety cut-out board [illegible] where wires are run to central distributing [illegible] located in closets. All the safety devices [illegible] provided with glass covers to keep out the [illegible] and at the same time allow of ready [illegible].

The whole system is carefully worked out to the smallest details, and the best experience [illegible] been brought to bear to construct the most perfect apparatus.

Chicago Electric Club.

The annual meeting of the Chicago Electric club was held Thursday evening, April [illegible]. President Barton presiding. The principal business of the meeting was the election of officers for the ensuing year. Messrs. Kemp[illegible] and De Land were appointed tellers, and the polls were open from 7 to 9 o'clock. Only one ticket was in the field, and it received the unanimous vote. The following [illegible] were elected for the ensuing year:

President, S. A. Barton.

[illegible] 1st, H. W. Leonard; 2d, [illegible]; 3d, Alex. Kemp[illegible]; 4th, D. L. Perry.

Secretary, W. A. Kreidler.

[illegible] S. Perry.

[illegible] L. Sunny, F. E. Degenhardt, [illegible] Knapp, [illegible] Baggot, H. A. Glaser, [illegible] M. [illegible], Geo. B. Baxter, C. K. [illegible], I. A. [illegible]

[illegible] W. H. McKin [illegible] J. H. Shav [illegible]

The question of new rooms was again dis- [illegible] assess each member $10 toward furnishing the new club rooms. [illegible] s stated that fifteen members would con- [illegible] $100 each, and other members would [illegible] sment. It was [illegible] l that the lease of the old rooms would [illegible] would give up [illegible] quarters at that time. [illegible] vening a lunch was served, and [illegible] the occasion. President Barton expressed the hope that dur- [illegible] the next twelve months the club would progress rapidly, the membership increase, and the [illegible] which had been [illegible] would be renewed. He antici- [illegible]

[illegible] Electric [illegible]

[illegible] ucting [illegible]

Electric Wires Taken Down in New York.

The sensation of the hour in electrical circles is the action of Mayor Grant of New York in ordering the poles carrying electric wires in the metropolis cut down. For two years the city authorities and the electric companies have been engaged in a controversy over the question of [illegible] after Mayor Grant's inauguration he began an active warfare on the companies, and so persistent was he that the Western Union Telegraph company, fearing lest he should take down its wires, appealed to the courts. This merely delayed the final action, for the court sustained the mayor. The order of Judge [illegible] vacating the temporary injunction obtained by the Western Union company in its suit against the mayor and the city was filed Tuesday morning, April 16th, in the clerk's office of the United States Circuit court, and a certified copy was given to Mayor Grant's [illegible] secretary at a few minutes after 10 [illegible], whereupon the following order was issued to the commissioner of public works:

[illegible] forthwith from the [illegible] and wires, also named [illegible] 716 of the laws of 1887, [illegible]

[illegible] Twenty-third street to [illegible] wires, except the wires [illegible] company upon the [illegible]

[illegible] Fourteenth street to Forty- [illegible] except the fire department [illegible]

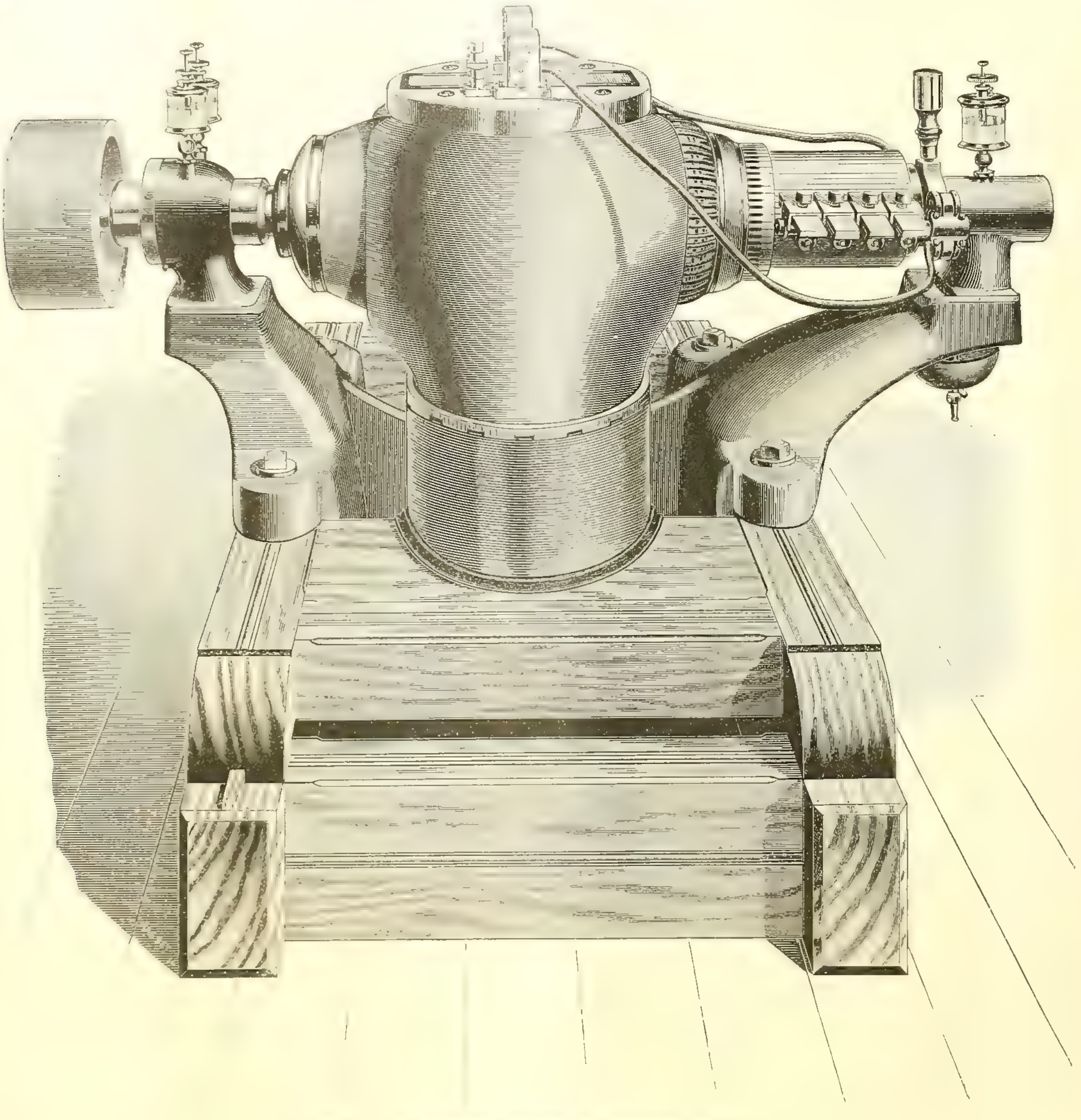
[illegible] from Sixth avenue to [illegible]

[illegible] from Sixth avenue to [illegible]

[illegible] from Sixth avenue to [illegible] poles on the [illegible] Sixth avenue.

And you are further directed to take up the removal of said poles and wires as described in the following order: Beginning on Broadway, at the intersection of Fourteenth street, and to continue up Broadway to Twenty-third street; then on Twenty-third street, from Broadway to Sixth avenue; then on Broadway, from Twenty-third street to Twenty-fifth street; then on Twenty-fifth street, from Broadway to Sixth avenue; then on Sixth avenue, from Twenty third street to Fifty-eighth street; then on Broadway, from Twenty-fifth street to Forty-fifth street; then on Forty-second street, from Sixth avenue to Madison avenue, the poles and wires referred to; then on Fifty-eighth street, from Sixth avenue to Fourth avenue.

The electric light companies were notified to turn off their current, and a force of twenty men was set at work. The first pole to be cut down stood on the west side of the park at Union square. It was a Western Union pole, and had a dozen Western Union wires on it. They were practically dead, anyhow, having been replaced by wires in the subway. The workmen were a trifle nervous or feeble, and their implements were not all highly civilized, and it took about fifteen minutes to get a pole down. The appearance of the workmen in Union square and the extremely novel work in which they engaged drew an immense crowd, which interfered materially with the progress made. Police were sent for, but they allowed crowds to gather as before, and vehicles and foot passengers to pass under the falling wires, and merely stood around and watched the poles come down. The gang at work on the east side of Broadway had easy work of it up to Seventeenth street, as the poles were burdened only with the few Western Union wires. All the poles except one on the west side of the park had been cleared off before noon, and at a few minutes before that hour the workmen buried their axheads in the root of the last one. This pole was standing directly oppo-



[illegible] 2 [illegible] INCANDESCENT SYSTEM.

site Sixteenth street, and the wires having been cut, was supported only by the guys attached to it. Only a few blows of the axes had been dealt when it began to sway dangerously. It was not a sound pole, and would probably not have stood long, anyhow. Orders had been given to the police to clear the street, but nevertheless they allowed Broadway car No. 333 to pass up right under the pole. The pole came down unexpectedly—actually fell between the horses and the front platform of the car. A

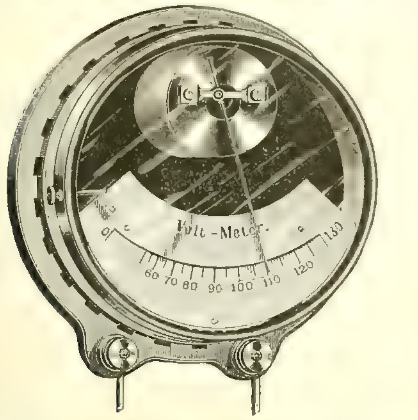


FIG. 5. THE WESTERN ELECTRIC INCANDESCENT SYSTEM.

foot to the right and it would have struck the horses, and a foot to the left and it would have struck the driver. No further accidents occurred until Thursday, when two accidents startled the community. The first accident was on Sixth avenue, south of Twenty-fourth street. Michael Early and Hugh Reilly, while holding the end of a guy-rope attached to the top of a 70-foot pole, were pulled from a third-story window, and dashed to the ground. Early was killed instantly and Reilly suffered internal injuries, besides fracturing his left leg and crushing his right foot. Contractor Busby and Foreman Roth, who were in charge of the work, were arrested on the charge of criminal negligence, but were soon liberated, as there appeared no reason for detaining them.

The second accident occurred at the southeast corner of Thirty-fifth street and Sixth avenue. A tall telegraph pole was standing there, directly in front of M. C. Cherry's trunk store. The pole had been erected by the old Atlantic & Pacific Telegraph company, and it is alleged, was twenty-one years old. About a dozen fire wires remained on it, the Western Union wires having been removed to the elevated road. Shortly before noon James Darney,

vestigated the condition of the other poles and found them rotten. No difficulty was experienced in punching holes into them with canes and the ends of umbrellas. They will all probably have to be removed with shearing poles.

Mayor Grant sent up word at noon that he wanted the big pole at the junction of Broadway and Fifth avenue, in front of the Flatiron building, removed at once. This pole was supposed to be the tallest in the city, and also the ugliest and biggest around. It has been an eyesore for years. More than 100 wires, forty-one of which belonged to the Metropolitan Telephone company, were connected on it. All the city's men were drawn from the various places at which they

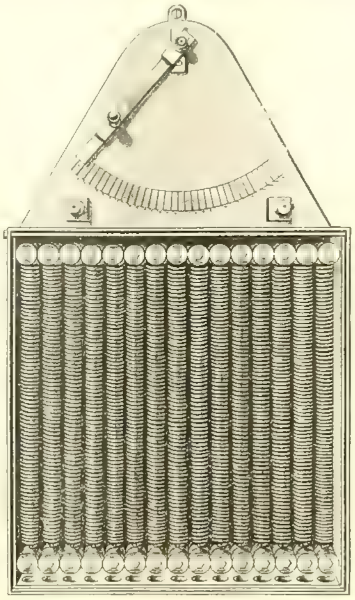


FIG. 4. THE WESTERN ELECTRIC INCANDESCENT SYSTEM.

had been working, to aid in taking this pole down.

For more than three hours a crowd of 10,000 persons gathered around this corner, one of the most crowded spots in New York, and watched the men at work. Police Commissioner McClave arrived at the beginning and took charge of the police arrangements. At his orders a line of policemen was stretched across Broadway and Fifth avenue, and for nearly an hour no cars, vehicles or foot passengers were allowed within the block between Twenty-second and Twenty-third streets on Broadway. All the wires were cut before 5 o'clock. The cross-pieces were

[illegible] darkness the first night, but alr[illegible]

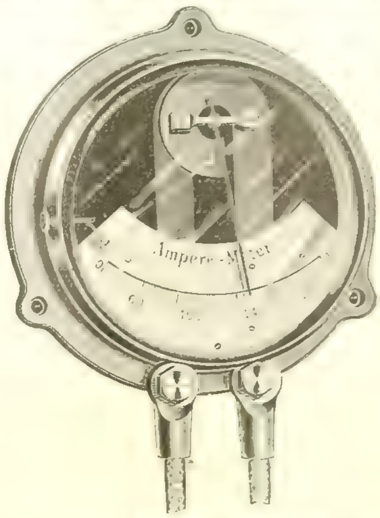


FIG. 6. THE WESTERN ELECTRIC INCANDESCENT SYSTEM.

and the others stirring themselves to get their wires in.

Many amusing incidents occurred in connection with taking down the wires. A well-dressed old gentleman with gray hair, who walked along the extreme eastern walk of Madison Square park Tuesday night, with his wife leaning on his left arm, was conspicuous even in the darkness of the park, because he carried an old-fashioned square lantern with an oil lamp inside. A crowd that stood in front of Barnum's circus gazed at the old gentleman in astonishment, and some in the crowd laughed. But the old gentleman, without heeding the sensation he created, kept on his way, swinging the lantern as if he were on a country road on a dark night. At 8 o'clock a dapper little man of thirty, with a light overcoat and a moustache to match it, had a crowd at his heels as he came down Broadway swinging a lantern.

The Western Union Telegraph company did not stop fighting when Judge Wallace granted

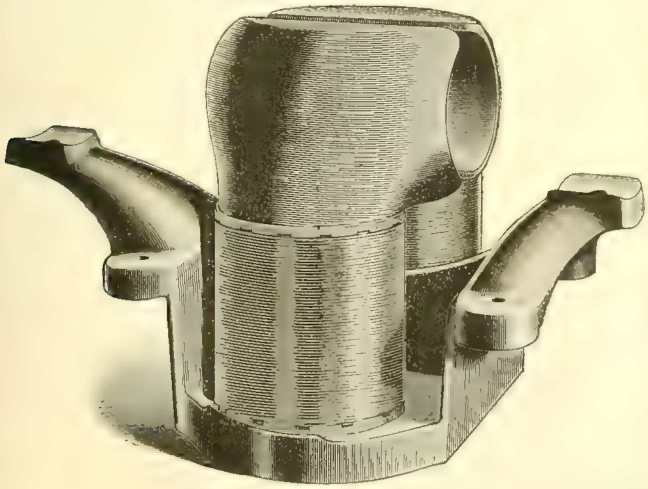


FIG. 3.

THE WESTERN ELECTRIC INCANDESCENT SYSTEM.

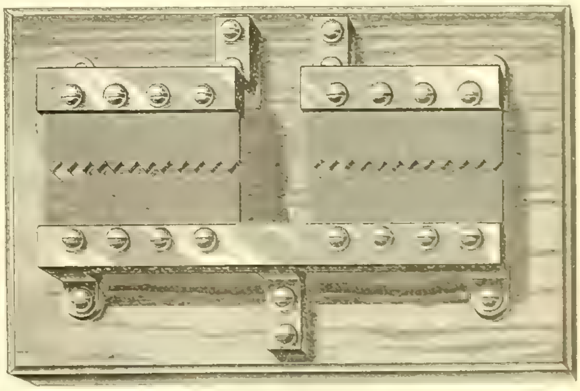


FIG. 7.

a lineman in the employ of the subway, climbed up the pole and began cutting the wires. Two had been cut when, without any warning, the pole toppled over, having snapped off short at the sidewalk. The pole was forty feet high, and Darney was well up. Every one expected to see him dashed to pieces on the stones, but fortunately the top of the pole fell over against the building. Darney, who had been descending hastily, jumped just before it struck, and landed safely on the walk. The contractor in-

then sawed off, and a shearing pole was erected. It took four able-bodied men ten minutes to chop through the pole at the bottom. It was safely lowered at 7 o'clock.

Just after the work had been begun the first day it was found that there were many live wires, and investigation proved that they belonged to the Brush company. At the office of the Brush company it was stated that the company discovered at 11:10 o'clock that the wires were being cut. The work had then been in

the order vacating the injunction [illegible]; on the contrary, it seemed to take [illegible]. The company, it is charged, [illegible] wires attached to the elevated structures for the purpose of holding up rotten Western Union poles. One of the latter at the [illegible] of [illegible] street and Sixth [illegible] dangerous but two guy wires [illegible] to the elevated structure, and when the [illegible] choppers arrived Saturday morning the [illegible] wires had been [illegible]

[illegible] placed and an officer stationed there to watch them. On this [illegible] ployed by the [illegible] pany, which is [illegible] at work sev [illegible] been killed, it is [illegible] Gibbens' precaution.

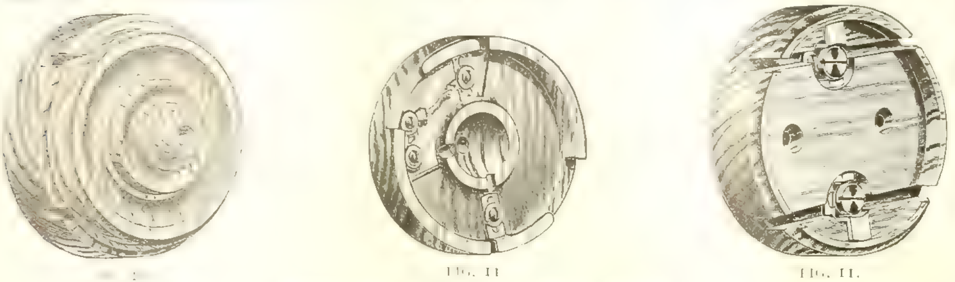
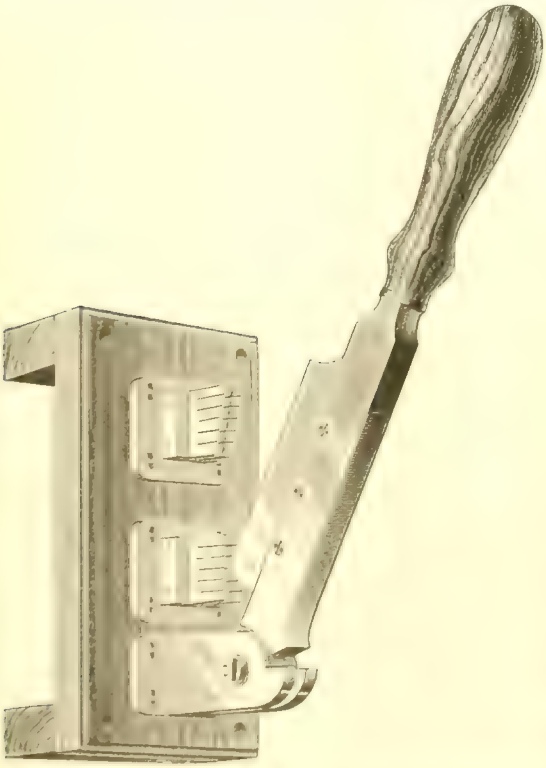


FIG. 11. FIG. 11. FIG. 11.
[illegible] WESTERN ELECTRIC INCANDESCENT SYSTEM.

[illegible] has thus attracted more attention than would otherwise have resulted, and, as a consequence, the subway commissioners have apparently devised a means of heading the company off. Judge Wallace enjoined the city from interfering with the Western Union wires on the elevated structure, but refused to embody a clause providing for running the wires to and from the structure. Two cables connecting branch offices with the main office via the elevated structure were severed by order of the commissioners Saturday.

[illegible] running into the branch office at 664 Sixth avenue, and the other at the southeast corner of Sixth avenue and Thirty-fourth street, where a cable of five conductors ran into a broker's office. Both cables ran over the sidewalk from the elevated structure, and were regarded as coming within the meaning of the law providing for burying the wires. There are a score or more Western Union branch offices dependent for communication with the main office upon the cables running on the elevated structures, and as the work of clearing the streets progresses these connections will doubtless all be severed, and the Western



[illegible]

Prof. Barrett on Mayor Grant's Action

[illegible]

York city, but he has public opinion with him, and, as a matter [illegible] could not have done a wiser thing. Broadway has been disfigured for years by poles—and such poles! Scraggy does not express it. Any one going from Chicago to New York can appreciate the fact that poles and wires disfigure streets. State street, Chicago, and Broadway, New York, are different looking thoroughfares, and those who have seen both can appreciate this comparison."

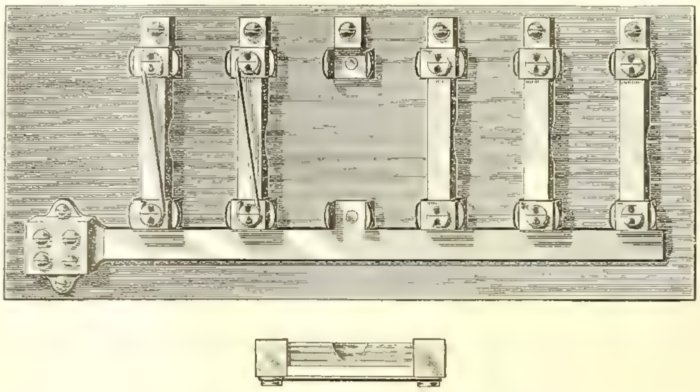


FIG. 9. THE WESTERN ELECTRIC INCANDESCENT SYSTEM.

"Do you not think that Mayor Grant was a trifle hasty in ordering the poles chopped down?"

"No. He gave the companies ample time,

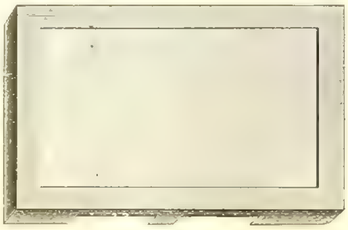


FIG. 12.

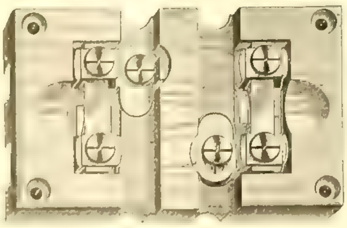


FIG. 12.

[illegible] warned them. For two years [illegible] have been disre[illegible] made a mistake in pursuing this course, and they have no one to blame but themselves if they were found unpre[illegible] in the course [illegible] New York know [illegible] There is no [illegible] The United States [illegible] that, but as [illegible] company assumed

control a notification was sent to the Board of Electrical Control, saying that the company was ready to comply with all the rules and requirements of that body. Now, if this company desires an extension of time, or anything reasonable, it can get it. Why? Because it showed the proper spirit. It submitted gracefully—showing that its managers were business men and not fools. As soon as the people of New York see the advantages of having wires buried they will wonder why they tolerated this nuisance of overhead wires as long as they have."

Electricity on Warships.

Electricity on ships of war is purely an American idea, and was first tried on the United States steamer Trenton in 1883, says the New York *World*. Soon after the system had been tested the vessel sailed on a three years' cruise, and attracted much attention as the first war vessel afloat to be lighted by electricity. The success of the Trenton's experiment practically settled the question in naval circles. Through the exertions of Lieut.-Commander R. B. Bradford, who was the Trenton's executive officer, electric lights were placed on the Vermont, New Hampshire, Omaha, Dolphin and Chicago. The Baltimore, Charleston, Yorktown, Bennington and Concord will be supplied with the latest improved plants, and there is nothing afloat that can excel the system. Each cruiser has about 500 lights, and the gunboats about 250, with sufficient supplies to last three years. All the cut-outs and switches are made watertight, and tested by turning a stream of water on any part of the circuit.

There are innumerable devices by which electricity is made useful on board ship. The value of the search light cannot be estimated, as scouting parties, torpedo boats or swift steam launches can be detected a mile away on the darkest night. As a motive power for small machines it is invaluable, and on the Chicago will be brought into play for training the huge guns of the main battery. It is used also for discharging the rifled ordnance, and the entire system is under the absolute control of the commander from his position in the fighting tower. He requires no uncertain assistants to place him in communication with the various departments of the complex machine. Electrical devices perform all the duties, transmit the orders and control the movements with far greater accuracy and safety than would be possible by the old methods.

The simple pressure of a button endows the huge monster with life and activity, causing 10,000 tons to glide smoothly through the water at a speed of twenty knots. At the touch of a second button the great shields swing noiselessly aside and the huge apertures are disclosed, filled the next instant by powerful rifled breech-loaders. There is a hush, a moment of expectancy, as the commander peers through the little slot on a level with his eye in the tower, touches a third button, and the cruiser vomits forth sheets of flame. The long steel shot dart through space at the rate of 2,000 feet in a second; bow, stern and broadside respond in one terrific roar, and, crash! the fabric trembles 'neath the simultaneous explosion of 6,000 pounds of powder, and 12,000 pounds of metal are sent whizzing through the air by means of the electric slave of the dynamo.

The merest motion of the little polished lever directly in front of the capstan brings the powerful search light into action, and sends a dazzling beam through the dark void. To the left protrudes still another concave innocent appearing globe, which controls a silent, though potent, and death-dealing auxiliary. A slight click is heard, a puff of white smoke, and the Whitehead torpedoes glide from their smooth tubes, and are driven through the water at the rate of thirty miles an hour. An electric bell signals the officer in charge of the quick-firing and machine guns when to play his part, and ere the gong has ceased to vibrate thousands upon thousands of explosive projectiles are flying through the air at the rate of 1,900 feet per second.

The latest electric appliance is a system of

FIG. 1. NEW YORK SUBWAYS.

engine-room telegraph, invented by J. B. Wallis, an Englishman. It has been thoroughly tested in the royal navy, and adopted on her majesty's ships Camperdown, Rodney and Aurora. It is also being fitted to the Magicienne and the Marathon, two second-class twin-screw cruisers. The Wallis system comprises an engine room telegraph, a revolution order telegraph and a steering telegraph, the principle being the same in each case. The engine room telegraph consists of a combined transmitter and reply indicator, inclosed in a case mounted on a pedestal. This instrument has a dial, around which the orders to be transmitted are distinctly marked, and a handle at the back turns a pointer to the desired command.

The moving of the handle or lever gives the "attention" signal to the engineer. The engineer putting his lever over causes a bell to be sounded on the bridge, which calls attention to the fact that he is acknowledging the order and repeating it back. The revolution telegraph is a simple means of transmitting to the engineer the number of revolutions at which the commander wishes the engine to run. The admiral may signal to the fleet that he is going at seventy revolutions, which signal has to be repeated to the engineers, in order that all the vessels may keep in line with the flagship. The steering telegraph is another application of the same principle. The transmitter and receiver are similar to those of the engine room telegraph, the latter being ingeniously attached to the rudder, which makes the record automatically.

In connection with the steam steering wheel, which in the fighting tower of an iron-clad is directly under the commander's control, he has at his disposal a terrible and decisive weapon once it is put in motion. Projecting a number of feet in advance is the ram attachment, its proportions and deadly qualities concealed under water. Emerging from whirling clouds of battle, guided by the will of the commander, the great fabric, impelled by the combined strength of the immense engines, with furnaces glowing and steam hissing, the cruiser rushes straight onward, prepared to crash into its opponent.

Testing Set.

A complete and portable testing set is shown in the accompanying cut. It consists of a sensitive detector galvanometer, set of resistance coils and keys. Each coil is separately standardized. The resistance coils are arranged in four rows of ten coils each. There are 10, 100 and 1,000-ohm coils in each arm of the bridge, thus giving an extreme range of measurement from 1-1000 to 1,110,000 ohms. The arrangement is such that only six plugs are needed in the set—one in each arm of the bridge, and one in each row of coils. The galvanometer can be turned and placed in the meridian line without moving the set. Means are provided for retaining the proper bridge connections when the galvanometer is moved. A needle lifter is provided, so that when the set is not in use the center pin will not be injured. The instrument is put on the market by the Electrical Supply company of Chicago.

TESTING SET.

The New York Subways.

Just at the present time the New York subways are attracting an unusual amount of attention. With their overhead lines disabled by the axes of the board of public incumbrances, the companies are obliged to make use of the subways whether they desire to do so or not. The accompanying cuts, which are reproduced from the *Scientific American*, illustrate interesting features of the system. Fig. 1 shows the brick manhole. The manholes are capped by a heavy iron curb, and provided with a double lid. The lower lid is held down in place by a gun-metal cross-bar and screw, and is provided with a tubular India rubber gasket, which is held in a groove and never leaves the lid. This gasket bears against a lip on the curb, so that when the lid is in place and the fastenings screwed, the hole is almost or quite hermetically closed.

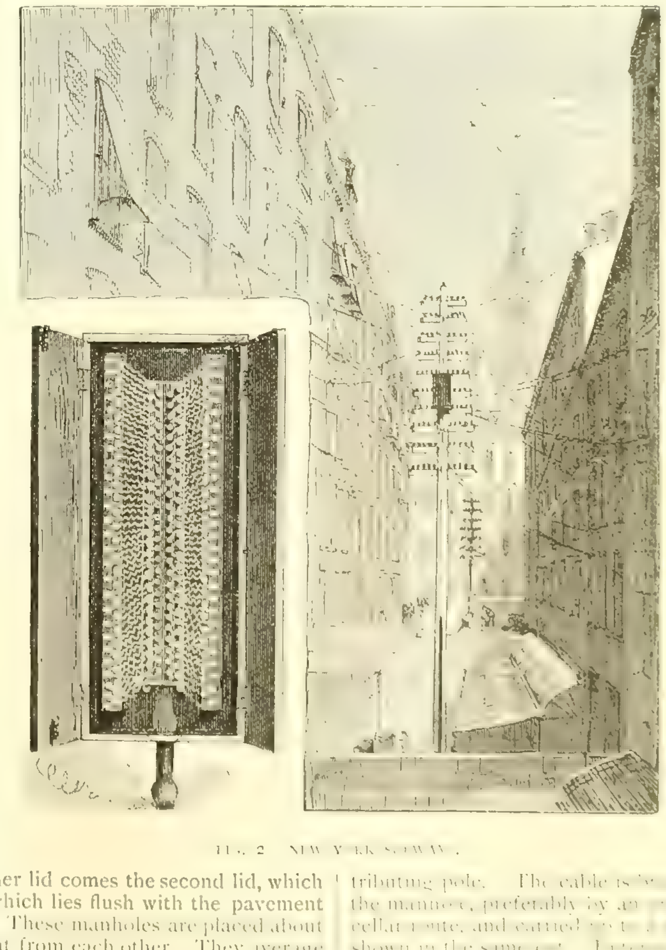


FIG. 2. NEW YORK SUBWAYS.

Above this inner lid comes the second lid, which is loose, and which lies flush with the pavement of the street. These manholes are placed about 250 feet distant from each other. They average one for each street block. Fig. 1 also shows the method of splicing wires and connecting cables.

[illegible]

and thence distributed where needed. The back yard system, shown in the cut, Fig. 2, involves the erection within the block of a single distributing pole. The cable is brought in from the manhole, preferably by an underground or cellar route, and carried up to a distributing box shown in the same cut. Entering this box the cable is opened and its wires distributed and carried to the cross arms of the pole, and thence to the houses requiring the service.

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IT will be noticed that the Kansas City correspondent claims that the city will soon be [illegible] its electric railways.

THE Wisconsin legislature adjourned last [illegible] session since war times. The members' wrangling over telephone and telegraph bills came to naught; none of the [illegible]

[illegible] are often [illegible] a Chicago [illegible] lamp [illegible] to enter the [illegible]

[illegible] ited opinions in [illegible] n, "What does our country [illegible]

[illegible] ss the bill is [illegible]

[illegible] plain- [illegible] general assembly to consider the bill carefully and to act promptly on the [illegible] of the council and the mayor will visit Springfield to advocate the passage of the bill.

AN English critic takes exception to certain statements in G. E. Fish's article on a "Standard of Resistance for Electric Light Circuits." He thinks the standard which Mr. Fish proposes in order to protect human life too low. He also presents some practical suggestions to make assurance doubly sure. The communication appears in this issue.

W. H. PREECE recently stated at a meeting of the London Society of Arts, that he objected to the use of the term horse power for an arbitrary unit. He said he hoped to live long enough to see the term horse power discarded altogether. Power should be spoken of only in watts, he thought. An English paper says it fears Mr. Preece will be doomed to disappointment. "Imagine," it says, "the impact of a shell from a 120 ton gun being reckoned in watts! It would be, as some one has previously remarked, like summing up our national debt in continental small change."

A WHEEL armature dynamo, patented by a Berlin firm, was recently illustrated and described in the WESTERN ELECTRICIAN. German and English papers stated that it had many novel points and it possessed marked efficiency. Within the last few weeks letters have been published denying both these statements. At least two inventors have claimed that they antedated the patentees of the wheel armature dynamo, and an English electrician in a communication, while admitting that the machine is ingenious and original, states that in his opinion its excellence has been over-estimated.

IN its comments on the recent convention of the Ohio Gas Light association, *Progressive Age* says editorially: "The recent meeting of the Ohio Gas Light association was remarkable at least in one particular, the amount of time given to the subjects of incandescent lighting and fuel gas. A very few years ago these matters were untalked of, at the assemblies of gas engineers; now with the electric light, they are (as evidenced at Mansfield) the engrossing subjects. The president's address, after the customary opening sentence, is devoted entirely to them." It might be added that it is only quite recently the gas journals recognized electric light as a competitor, and pooh-poohed the idea until they were obliged to admit the fact that electric lighting was making giant strides and promised soon to outstrip them.

R. G. DYRENFORTH of Washington, who was connected with the patent office for almost twenty years prior to 1885, has been interviewed by a Detroit paper concerning the work of the patent department. After stating that the United States patent system is the grandest in the world, and that it protects the most ingenious and practical inventors on earth, Mr. Dyrenforth speaks thus of the methods in vogue: "There is certainly more absurdity there than in any other bureau of the government, and if any firm or private corporation employing [illegible] people were to permit business to be done as it is done in the patent office, or were to allow methods to obtain which obtain there, such firm or corporation would be bankrupt before the end of six months." He also [illegible] "A more trifling set of [illegible] than is sprinkled through the ex[illegible] would be hard to find, and their [illegible] the inventor and beat him down and haggle, until, if a claim is [illegible] as to be of no [illegible] these little creatures, [illegible] in the patent office, [illegible] defeat an applica[illegible] then, at least, to [illegible] They con[illegible] advocates of the [illegible] and forced [illegible] known matter in [illegible] pertain, and by raising all the multitudinous technicalities made possible by the complex, intricate and unnecessarily voluminous rules of the patent office, even when forced to acknowledge the existence of an invention of great scope, will do all in their power to outwit the inventor or his attorney."

Mr. Dyrenforth makes no particular suggestions for the improvement of the office, but merely says: "The patent office needs weeding of old moss as well as of young sprouts." He has a good word for the new commissioner of patents, and says: "I am sure that he will make a just and an able commissioner, and that he will not let the examining corps ride him nor let each examiner set up a little patent office of his own."

IT will be remembered that in Prof. Forbes' paper on "Central Station" lighting, which was published two weeks ago, a reference was made to the underground lead cables in Berlin. It was stated that they were destroyed by electrolytic action within three years of the time they were first laid. The statement caused quite a stir in English electrical circles, and the truth of the assertion was questioned. A flutter was caused in several English companies which are considering the underground question. The matter was brought before the Berlin Electrotechnical society by Dr. Werner Siemens, who emphatically denied Prof. Forbes' statement. He stated four failures had occurred in the Berlin underground mains, and that these had been due to mechanical injury. Owing to the want of proper supervision, and especially owing to the impossibility of performing frequent tests where the mains of different districts are all coupled together as in Berlin, the faults were not detected in time to prevent failure. It had been necessary to replace less than one-sixth of 1 per cent. of the cables. Dr. Siemens took up another interesting subject. He gave it as his opinion that in a short time the available space under the streets of large towns will not suffice for the accommodation of the various cables, gas and water pipes, and sewers, nor will the surface of the streets suffice for the increased traffic, and he looks forward to the rearrangement of large towns, where there will be streets on two levels. The new streets, either over or under the existing ones, are to be exclusively used for express service with electric tramways, and for the placing of the various conductors for telephony, telegraphy, light and power, gas, water, compressed air and steam.

LAST week was an eventful one for electric companies in New York city. Mayor Grant made good his threat to remove overhead wires, and workmen have been kept busily engaged in chopping down obnoxious poles. We have taken some pains to ascertain the views of Chicago electricians in reference to Mayor Grant's action, and their opinions seem to be of a commendatory character. They think that the New York companies had been given ample time to bury their wires, and it was necessary for him to adopt heroic treatment. What will be the effect of the events of the week throughout the country? Certain it is that the daily press has heartily commended Mayor Grant's action. In several cities the papers have held him up as an example which the local authorities would do well to imitate. This is true in the case of cities in which there is apparently no good reason why the underground question should be violently agitated just yet. A gentleman, a day or two ago, thus formulated his fears on the subject: "Mayor Grant was not hasty in his action, and I believe he was thoroughly justified in adopting extreme measures, but I am afraid of the influence of his action throughout the country. Every mayor will begin to think it is necessary for him to imitate Mayor Grant's example. In small towns the overhead system is by no means objectionable, yet the authorities, thinking their little places are to grow into cities like New York, will be inclined to force companies to bury their wires, so as to begin right. Another effect I am afraid the New York incident will have, relates to the companies. It will tend to make them too cautious about extending their overhead circuits, for fear that an underground ordinance may cause them to remove their wires in a comparatively short time."

Sprague Electric Railway at Akron, Ohio.

The accompanying engraving gives a view of the Sprague electric cars on the Akron, O., railway. This road has been in operation about three months, and has given great satisfaction ever since it was put in operation. The management have felt so well pleased with their electrical equipment that they have ordered a similar equipment for the principal railway at Erie, Pa., which is owned principally by the same stockholders.

Detroit Storage Batteries for Train Lighting.

The Woodward Electrical company of Detroit, Mich., has fitted up a passenger coach on the Michigan Central railroad, and is testing its system of train lighting. Thus far it has proven satisfactory. The coach is run between Detroit and Chicago on the night train, and the system has been given a thorough test. Fourteen Edison lamps are arranged in this car, and on the platforms, and they furnish a brilliant light. Current is supplied by Detroit storage batteries, which are charged at Detroit for each round trip. Twenty-two cells are used in each car. They are arranged in four boxes underneath the car, and can be charged without being removed from these boxes. The objection to the weight of these cells, it is said, is groundless. It is scarcely felt, it is said. Electrician Stiley of the Woodward Electrical company, who superintended the installation of the plant, was in charge of the car during the first trip, but his services were not required. He said the lights burned brightly, and were admired by all who saw them. The officers of the road are well pleased with the operation of the plant, it is said, and will soon extend it, lighting all of their principal trains.

SPRAGUE ELECTRIC RAILWAY AT AKRON, O.

Standard of Insulation.

In Vol. IV, No. 4 of the WESTERN ELECTRICIAN appeared an article on "Standard of Insulation for Electric Light Circuits," by G. E. Fish, of Chicago. The article was copied into several of the English electrical papers. A correspondent of the London *Electrical Engineer*, who signs himself "Querist," writes to that paper as follows:

I have read Mr. Fish's paper in your last issue with much interest, but I find it impossible not to take exception to his first conclusion, as to the standard of insulation to be adopted in order to obtain immunity from danger to human life. I object to it principally for two reasons: (1) That R is a variable and not a fixed resistance, and (2) the value of C as a death-dealing factor is not known with sufficient accuracy. Mr. Fish having obtained 4,000ω to 15,000ω as the hand-to-hand resistance of several persons, takes a somewhat curious mean of 5,000ω—a hard and fast mean, be it observed—and proceeds to calculate the value of C in each case, assuming E and R to be fixed quantities. Now this appears to me to [illegible] the safety of [illegible] based upon a [illegible] so long as [illegible] along to dist[illegible]. From [illegible] 5,000ω [illegible] considered, a rather [illegible] as the [illegible] hand-to-hand resistance of [illegible] My own tests are higher [illegible] a fact that if the hands are moist—if the [illegible] the resistance [illegible] and in this case Mr. Fish's first value [illegible]

$$\frac{1,000}{500} = 2 \text{ amperes.}$$

To my mind a provision which depends upon an [illegible] and extremely variable physical condition, upon the [illegible] of the contact made, and upon other considerations [illegible] it is not necessary at present to discuss, is [illegible] factory. The matter is an important one, but as the question really deals with workshop practice, not calling for any elaborate theories, would it not be best met by taking means to insure the invariability of R within reasonable limits? This might be done with less trouble than is now entailed by the precautions governing the safety of coal miners, and if insisted upon by those having control of electric light and power enterprises, should procure immunity from danger for those engaged in practical work. Suitable clothes, etc., should be worn, and the hands and wrists soaked in a non-conducting oil or composition, or frequently dried with a naphtha or paraffine rag. Before engaging in any possibly dangerous work the resistance of the operatives should be measured. In this way the risk would be greatly minimized. You would not venture to place a delicate instrument in circuit with an unknown e. m. f.; why should you, then, venture a human life blindly? If a law were passed prohibiting the employment of workmen whose hand-to hand resistance should at any time during working hours be less than ten times the voltage, a way would very soon be found out of the difficulty.

The Results of the Adoption of Electric Lighting by a Gas Company.[1]

BY L. A. STRONG.

On broad business principles, the sentiment and action of the day are in the direction of the consolidation of kindred interests, prompted by considerations of economical administration and efficiency for resultant gain. On all sides and in every department of the business world we note conspicuous examples and great successes. In this point of view, with similarity of purpose, there seems nothing more natural and inviting than the practical consolidation of the rival lighting interests (gas and electric), a combination of business with best conditions for securing economy and efficiency of service. Recognizing the presence of electricity in the field of illumination, with its wonderful power backed by a popular demand that must be met, it seems to stand before the gas interest as its "best friend or dearest foe." These considerations prevailed with us here [Mansfield], and induced a consolidation of the gas business with a local electric lighting company, which was struggling along under indifferent, unsatisfactory results in its independent capacity.

We may spread and cover pages with theories, but it is the condition of satisfactory returns that interests and convicts, and while it may be questioned if here, we have had experience long enough to determine and settle definitely the doubts of conservative inquiring minds, so far the consolidation has met the moderate expectations entertained when we determined our action.

[illegible] gas furnished to the street lamps, with the [illegible]

[illegible] fair profit.

We started our plant in November [illegible] item for repairs, and for the year closed have had manufacturing profit on the business.

In view of what might be inferred from the subject assigned to me, I may have indulged in [illegible] statements, many of which have been previously considered and weighed, but, while considerations that [illegible] gest themselves hardly permit a statement here of operations, we shall be glad to give all information possible to those considering their interests, and we wish to add the confirmation of our experience to that of those who preceded us in the plan of combination and [illegible] to peace and prosperity.

Disturbances Arising From the Use of Earth for Electric Lighting Purposes[1].

BY W. H. PREECE.

The magnetic field produced by a current flowing in a straight wire, and returning through the earth, extends to such distances that it is quite impossible to say where or when or how a telephone circuit in that field would be disturbed by any changes in that current. It is quite certain that if a single conductor between Deptford and London were subject to rapid alternations under a potential difference of 10,000 volts—the current returning by way of the earth—every telephone circuit in the metropolis would be disturbed and probably rendered unworkable. The law determining the distance to which this influence extends was given by me in a paper read before the British association at Manchester in 1887. It is given in the following equation:

[illegible]

c_1 being the primary current, c the secondary currents, [illegible] the length of the primary, [illegible] the distance between the wires, [illegible] the resistance of the secondary, [illegible] a constant dependent on the frequency of the primary currents and the rate at which they rise and fall.

It follows from this formula that currents of rapid frequency on a conductor ten miles in length, carrying [illegible] amperes, might be evident at a distance of [illegible] It becomes, therefore, important to decide to what extent disturbing influences can be eliminated. It is well known that if either the disturbing circuit or that disturbed be constructed of two wires so close to each other and so [illegible] that the mean average distance between the disturber and the disturbed is the same, no inductive effects are [illegible] for the influence on one wire is entirely neutralized by the equal and opposite effect on the other. [illegible] average distance is not equal, or if [illegible] currents be departed from, then a [illegible] which will depend on the difference between [illegible] rents and their relative distances. [illegible] perfectly silent telephone circuit [illegible] occur in the insulation, and hence [illegible] such an important part in the [illegible]

It was reported in the technical papers [illegible] Electric Supply corporation [illegible] central conductor between Deptford and [illegible] external copper conductor [illegible] it seems [illegible] the [illegible] such an arrangement would [illegible] experiments were made to test the [illegible] were made in an open space [illegible] extent. A concentric cable was [illegible] outside or enveloping conductor [illegible] The [illegible] conductor was composed [illegible] conductor completely surrounded the [illegible] twenty [illegible] B. W. [illegible]

[1] Read at the convention of the Ohio Gas Light association, March, 1889.

[1] [illegible]

...s per mile, and ...e sheath was of ...

...the arrangement ...

...and ...wire was laid along the ...

...ever ...

...were simultaly ...

...4.—The points, C and D, were not con... ...a telephone being inserted at D. Disturbances almost as loud as on ...

...was disconnected ... The inter... ...half as loud as ...

...The ... conductor, O, and the lead sheath, L, were coupled together, forming jointly a return wire in contact with the earth. The disturbance in ... reduced in loud... ...experiment.

Experiment No. 8.—The cable was next laid out straight from A to B, the telephone wire being parallel to it. When ... wire, loud disturbance was heard in the telephones at A and B. When the lead sheath and outer conductor were jointly used as the return wire, the noise in the telephones was greatly reduced (to about one-fourth).

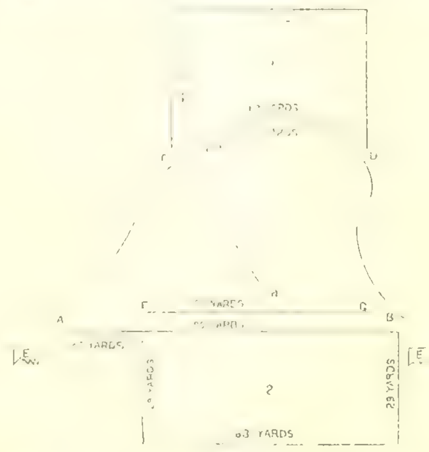
Experiment No. 9.—To prove that the result obtained ... earth conduction, a ... in diagram) was formed, and the disturbance in the telephones disappeared.

It follows from these experiments that the disturbance of the potential of the earth at A and B and the establishment between these two points of a potential difference cause currents to flow through the earth between A and B which destroy the equality between those in the inner and outer conductor of the concentric cable upon which equilibrium depends. It is, therefore, quite clear that the use of the external sheathing as part of the conductor in contact with ... whereas, if the enveloping conductor be insulated it is quite innocent of ...ance, and would not interfere with neighboring tele...

...the currents experimented with (viz. those produced by a Wheatstone ... the same character as those produced by ...ernating current machine. The frequency in the two ... Wheatstone ... machine, will rise ...um and fall from maximum to zero in ... res, while that ...

Electric Wiring of Buildings.

... contingencies will be met with ... and what faults will ... Throughout past experiences it has been found that the practical pressure of electricity for electric lighting is, within fifty per cent. either ... copper, and the most ... in many modified forms. The insulated conductors are usually protected and held in position by wooden casing. We need hardly question the object of the conductor, but what is the object of ... conductors, if held in good, dry wood casing only, would be protected from interference ... the worst contingencies ... ever working evil on electric light wires. If you place a copper wire in water with electricity passing along it, the copper will be removed electrolytically from the part of the wire where the electricity enters, and deposited where it leaves. The same process goes on where uninsulated or badly insulated electric light wires lie in water or surrounded by moisture. Even though no electricity is flowing through a copper wire exposed to moisture and the atmosphere, it is acted upon chemically. The result of the electrolytic and chemical actions on electric light wires is to thin them and make them insufficient for carrying the current, and consequently they become heated. Or the result may be that the wire is eaten through when an electric arc is produced. This effect or fault is called an opening circuit, and is about the most ... dangerous fault to contend with. It is ... light leading wire in a groove in the casing ... parallel to the return wire. Water often saturates the casing between them, and when the insulation is poor the electricity will pass through the moisture ... often setting it in



flames. Faults such as this where a great leak is taking place between the wires are called partial short circuits, and are equally difficult to avoid and as dangerous as opening circuits. The study of the insulation of the wires is therefore obviously of great importance.

After describing the process of covering wires with India-rubber, Mr. Andrews continued: The next contingency that has to be contended with is mechanical damage. The wires being more or less flexible and the covering soft, they are easily damaged. This difficulty is usually met by casing the wires in wood, and it being necessary to employ two conductors for electric lighting, the casing has two grooves, one for each conductor, a cover being fixed over them. Wood casing has the disadvantage of harboring moisture. Another method of protecting the wires is that of sheathing them with an outer covering of wire. This method protects the ... much more effectually than ... and does not harbor moisture. Iron pipes ... in many cases, and are an excellent protection ... in them, and if there should ... it is sure to find it. There is ... opening circuit and partial short ... a dead short circuit, ... the opposite conductors. This ... were not that there is a ... it would also be ... usually happen ... are necessarily ... points the insulation ... and proper short ... the wires ... gas and water ... faults ... the ... a distance apart. ... plication of fuses ... such as the ... not increase the ... but quite ... point of danger from a ... that of an attendant for the ... We will consider later how this, to a certain extent, can be achieved. In the foregoing we ... considered many the contingencies or dangers arising ... the introduction of electric light into buildings and we may summarize the main points as being an opening circuit, a partial short circuit, a dead short circuit, and the fuses. We have considered the dead short circuit to be met by the fuse, although a new element of danger is introduced, which, however, is much less in degree. This new element of danger can be reduced to one-half by connecting one of the leading wires, say the positive, to the earth and the gas and water mains, it being only on account of the latter that it is otherwise necessary to provide a fuse on each wire. This method of connecting one of the wires to earth is best called the earth system. It is however, often called the single-wire system, because in its application to ships the hull of the ship is used as the return wire. In buildings, however, two conductors are required, and, as it is important always to be able to distinguish between the negative wire, in which the fuses are inserted, and the positive wire, which is connected to earth and all the electrical fittings, the positive wire is colored red, and the negative wire black. The object of connecting the positive wire to earth is, that red colored wires are usually inferior in insulation quality to black wires, and it is not so important that the return or earth wire should be so highly insulated as the leading wire.

We now come to the consideration of means for minimizing those most dangerous faults, opening and partial short circuits. Except the means proposed by the writer in the following paragraph, no attempt has been made to treat these faults, except by good workmanship and material. The proposal the writer makes is to universally adopt the sheathed or armored wire system devised for use in the exposed and damp places on board ship, using the earth wire system, and now extensively used for that purpose. The virtue of this system is that all faults, partial short circuits and opening circuits, are reduced to dead short circuits. It will be understood that the copper wire is the lead and the iron wire the return. It was assumed in devising this system that the opening circuit in the outer conductor was very unlikely to take place, and so it has been found in practice. It is, however, possible that the inner conductor, through undue strain or a flaw, might have an opening circuit in it; and if such were to take place the immediate result would be that the heat generated would destroy the insulation between the two conductors, and at once effect their fusion together and a short circuit. As a matter of fact, however, short circuits in this system have in practice been many fewer, and there have been no opening circuits or partial short circuits. How many of the short circuits were due to such faults is difficult to say; the causes of some were doubtful. In addition to the advantages above referred to, there is another, not of least importance. The electricity being entirely inclosed within the outer conductor, and the electric pressure being only from the center point to the outer conductor, it is impossible to get a shock through anything more than a very small part of one's flesh, such as the finger end, except by wilful contrivance.

With any system of supply embodying the series system I may generally say it is not advisable to employ an earth. I have expressed this point broadly, as it involves complex considerations which would take long to make quite clear. But with all systems on the parallel system there are many points favorable to an earth connection, some of which can be gathered from foregoing descriptions. There is one other circumstance worthy of mention in favor of earth connection. Should the wire system at any time be struck with lightning, there is at once a safe connection to earth, instead of having to pass through a highly insulating material, as when there is no earth connection. Lightning has already been known to strike overhead electric light wires and discharge itself through the dynamo to earth, to the imminent danger of the machine.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 20.—The latest developments in the failure of the Callender Insulating & Waterproofing company are unsatisfactory, and ugly rumors are in circulation. William M. Callender, president and treasurer of the company, is said to have returned to England. At the meeting of the creditors last Wednesday afternoon at the Astor House, the committee which was appointed at a former meeting to investigate the condition of the affairs of the company, made an unfavorable report. The books were in such bad shape that it was impossible to obtain any satisfactory information. The committee reported it had found evidence of errors and great carelessness, and in view of these facts the creditors applied for a receiver and recommended ... Bardick of Chicago for that position. The application was granted. Morgan & Worthington, counsel for the company, have been retained by Mr. Bardick, and the books are in their hands. At present there is very little prospect of the creditors receiving much. The creditors are bringing suits and obtaining judgments. It is rumored that ... sum of money has disappeared which cannot be accounted for, and the sudden departure of president Callender for Europe does not make the matter look any better. The creditors have been patient, but since the latest developments pointing to irregularities, they have become indignant and determined to bring to light the manner in which the Callender conducted their business.

The annual meeting of the Electric club was held last

Thursday evening, and the following officers were elected for the ensuing year, beginning May 1st:

President—E. T. Gilliland.
Vice Presidents—O. E. Madden, [illegible] Dickerson, Theo. N. Vail, H. C. Davis.
Secretary—Chas. W. Price.
Treasurer—Willard L. Candee.
Board of Managers—M. W. Goodyear, H. [illegible], A. H. Patterson, Cyrus O. Baker, Jr., Henry A. Reed, [illegible] H. Barney, John A. Seeley, W. H. Johnstone, Geo. B. Coggeshall, J. C. Tomlinson, Chas. W. Spear, H. D. Stanley, C. E. Stump.
Committee on Membership—Henry Hine, Lieut. [illegible] W. Toppin, U. S. N., Geo. T. Manson, Geo. Worthington, Henry D. Lyman.

A pleasant entertainment followed, and was enjoyed by the members. It included instrumental music by an electric piano which is an interesting and novel invention. The attendance was large and the outlook for the club is promising.

The action of Mayor Grant in causing the removal of the poles from streets in which there are conduits caused quite a sensation. Considerable progress has already been made in this work, and the streets are scarcely recognizable where the work has already been completed. One would scarcely believe that so great a change in the appearance of the thoroughfares could be possible. The streets seem to have broadened to twice their former dimensions. It is expected that all the streets will be cleared in time for the Centennial celebration, and it will be a great advantage for the parade. Connection will at once be made with the conduits, and the electric lights will be in full blast in time for the celebration. Very elaborate preparations are being undertaken for illumination during the Centennial, and the removal of the poles and wires will not in the least retard the completion of the electric illumination. The Brush company seems to be the principal sufferers through the mayor's action. They will soon have arrangements completed for supplying their patrons. It is to be regretted that the removal of the poles entailed the loss of life, and it is to be hoped that this accident will prove a warning, and that greater precautions will now be taken in order that there will not be a repetition.

Mayor Grant's rapid transit bill has been practically buried. It is, of course, possible that it may be considered by the present legislature, but it is not probable. At the moment selected for making an effort to secure the passage of the bill, its friends allowed themselves to be entrapped and did not discover their mistake until it was too late to rectify it. It had been agreed to consider the bill last Tuesday, and it was made a special order, but before the hour for taking it up had arrived, the senate went into a secret executive session to consider the nominations presented by the governor for a few New York offices. The opponents of the rapid transit bill succeeded in getting the New York members into a discussion, and kept the fight up until it was time to adjourn, which, of course, threw the bill back with others of its kind, and now there are fifty ahead of it. It is hardly possible that it can again be brought up for special consideration. Residents of this city are indignant at the stupidity displayed by their representatives in allowing themselves to be thus duped.

Another measure which has been virtually killed at Albany, in which the people of this city were interested, was the Hamilton telephone bill, regulating the charges for the use of telephones. Every effort was made by the advocates of the bill to secure its passage the services of the sergeant-at-arms were enlisted to hunt up the members who were not present when the bill was called up, the halls, committee rooms, etc., were scoured for absentees, and the roll was repeatedly called, but all to no purpose. It was impossible to secure the requisite number of members, and the bill was shelved for this session.

The Baltimore Automatic Transit company is conducting experiments in the interests of rapid transportation of express, mail, and other light freight. A circular track two miles in length has been constructed, and an Edison dynamo and Sprague motor are employed in the present experiments. Prof. Rowland of the Johns Hopkins university and Thos. A. Edison have both passed upon the scheme as entirely practicable, and Mr. Edison is said to have declared enthusiastically that it is the greatest conception since the telegraph.

NEW YORK, April 22.—Application was made Saturday to Judge Bartlett in the Supreme court, Brooklyn, for an injunction to restrain the Electric Sugar Refining company from removing any of the fixtures from 18, 20 and 22 Hamilton avenue. This was the building occupied by the company, and there, it is alleged, the process of hoodwinking the stockholders was successfully carried out by means of the famous "secret room." Since the collapse of the company efforts have been made to remove some of the fixtures, but Receiver Johnson objected, and the injunction proceedings were the result. The company claims that the machinery was worth more than $[illegible]. Justice Bartlett reserved his decision. [illegible] V. H. [illegible]

Kansas City.

KANSAS CITY, MO., April 20.—[illegible] City will become noted as an electric [illegible] now [illegible] city. The Metropolitan Street [illegible] company [illegible] in Armourdale. [illegible] the Thomson-Houston system being used. The Citizens' Investment company, which [illegible] street [illegible] ready to [illegible] for the [illegible]. A Kansas City, Kan. electric line has been projected for some time, and now the [illegible] Street Railway company has decided to build an electric line from the very heart of the city east to a point about [illegible] miles distant.

The Blue Valley company has purchased the Independence Avenue horse car line from the Metropolitan Street Railway company for $75,000. The present western terminus of the horse car line is at Fifth and Walnut, where the Metropolitan long Fifth street cable line begins. The eastern terminus of the horse car line is at Independence and Woodland avenues, just one block east of Highland avenue. The city council granted the company the right of way along the proposed route last week. The Blue Valley company is a reorganization of the old company, which for the last two years has been negotiating with the Union Cable company to run the eastern end of the line. Bids are now being received for the construction of that part of the road. The location of the power house has not yet been decided upon, nor has the system of electric motor power been chosen.

The Citizens' Investment company, who own the Vine street line, have arrangements all completed. C. S. Rustling, agent for the Thomson-Houston company, has secured the contracts for furnishing the electric system, and it is to be ready for operation June 16. Three carloads of material for the Armourdale line arrived last week. This road is to be in operation by July 1. Single cars will be used, while on the Vine street line trains of two cars will be run. The Thomson-Houston company will operate the Vine street line for thirty days before it will be accepted by the Citizens' Investment company. Two or three lots along the road have been considered as a location for the power plant, but neither has been selected. The electric improvements will cost $50,000. The line, which is two miles long, is now in operation as a steam-dummy line. The road will be extended. The extension will be made if property holders south of Springfield avenue will give a bonus. The amount of this has not been definitely fixed, but the amount will be in the neighborhood of $20,000, and the matter must be settled this week. The electric line will continue the contract made between the dummy line and the Metropolitan cable roads for a transfer system. The electric line will pass by Troost Park, and an entrance has been secured on the east side of the park, where the line will have a station.

The low rate telephone bill passed the lower house of the Missouri legislature by a reported vote of 73 to 65. It required 71 votes to pass the bill. It is a remarkable fact and not easily accounted for, that several interested parties who were in the house at the time kept tally on the ayes and noes, as they were called, and made the ayes only 67, and their surprise was consequently considerable when the result was announced. Two or three legislators were found, who, after comparing their vote as recorded with their recollections, stated that their vote was opposite to that indicated by the roster, but only one could be found who possessed sufficient stamina to make the necessary complaint to the house, and have the proper alteration made. This reduced the majority by one, but the bill passed.

President Mulvane of the Missouri & Kansas Telephone company states positively that he will not do business at the rate indicated by the bill, which is $4.00 per month for all instruments inside the limits of cities having over 10,000 population, and 15 cents for each five minutes' talk over toll lines. It is, however, almost impossible to induce the public to believe that such will be the case, so that the probabilities are that the low-rate agitators will suffer somewhat by the consequences if the bill should pass.

Superintendent Smith was asked if he thought the senate would also pass the bill. "I am almost positive," he said, "that that body will not, at least not in its present form. The bill is now in the hands of a committee, and there is some talk of amending it, but I am not able to speak as to that." "What will be the consequences if the bill passes both houses?" "We will go out of business or transfer our plant to Kansas City, Kan., and from there continue to serve Kansas City patrons. It will be an expensive move, however, but the passage of the bill will drive us to it, as it costs more to operate the plant than would be returned [illegible]

[illegible]

good results. That night Mr. Dempsey, the author [illegible] bill, appeared before the committee and made an argument in favor of its passage. The [illegible] report [illegible], compromising [illegible] proposed by the Dempsey bill and the present rate of charges.

Omaha, Neb.

OMAHA, April [illegible].—The local telephone [illegible] business has been extending rapidly, and now it is thought there are 125 miles of wire operated. Manager Low said recently: "We have at present 330 subscribers, and this number will be increased to 400 before the end of the present year, judging from the way in which applications are now coming in. We are so busy just now replacing the wires on the Upper Broadway poles that we have barely time to attend to these applications. New wires have to be put up every little while, and it is quite a job."

A cross wire supporting the overhead circuit wire of the electric motor line in front of the Ogden house, broke recently, fell across the main wire, and whenever the end touched the rails a report like the crack of a pistol followed, accompanied by flashes, making a brilliant scene. The line was repaired immediately.

The proposed new motor line is receiving encouragement. The southern part of the city desires direct and cheap communication with Omaha, and a large portion of the city lying south of Broadway is equally anxious for increased accommodations. The right of way asked for along certain streets indicate that the new company is planning to use the Union Pacific bridge for crossing the river, and from the approach to that bridge will run up into the city, thus accommodating the southern part of the city, which is too far from the present electric motor line. Since the completion of the Broadway bridge the [illegible] portion of the Union Pacific has not been patronized sufficiently to pay the expense of watchmen and ticket takers. It seems quite likely that the new motor company [illegible] lease it at a reasonable rate. [illegible] company it is not unlikely that [illegible] trains, morning and evening, may be secured. [illegible] ing of Broadway bridge and the starting of the [illegible] motor line brought down the rate between [illegible] from 25 cents to 10 cents. It is stated [illegible] motor is paying well. With [illegible] cheap trains morning and evening [illegible] could doubtless be [illegible] same time the [illegible] is granted the new company [illegible] more a part of the [illegible] enough for those who [illegible] occasionally.

[illegible]

[illegible] means of [illegible] constitute a [illegible] to the purpose [illegible] mplates the placing [illegible] in which [illegible] ght-of-way franchises [illegible] of our streets [illegible] by the city to [illegible] include part of [illegible] street, but the [illegible] the heaviest [illegible] and the [illegible] of water, gas [illegible]

Cincinnati, O.

[illegible] George B. Kerper's [illegible] trial trip Wednesday, [illegible] from the cable [illegible] to the terminus of the [illegible] street branch of the road. The only difficulty experi[illegible] of the cable road. Here [illegible] but it is expected that [illegible]

Yesterday afternoon Mr. Kerper closed an agreement [illegible] the Montgomery pike whereby his electric road will be run out the Montgomery pike as [illegible] and other consider[illegible] feet on either side of the pike from the present terminus of the cable road to [illegible] distance of over a mile. He will begin build[illegible]

[illegible] were in the city yesterday inspecting the electric street railways.

Sheriff Sawyer has attached the wires of the United Lines Telegraph company in Cuyahoga county in obedience to an order from the Superior court at Cincinnati. This [illegible] extending a distance of sixteen miles along the Cleveland & Canton Railroad and terminating near Sherwin, Williams & Co.'s works on Canal street. [illegible] aggregate ninety-six miles in length, were [illegible] The order, which was made in the case of Edward Harland, receiver of the American Rapid Telegraph company, directed the sheriff to attach all instruments and office furniture owned by the Mutual Lines Telegraph company in this county, but the sheriff was un[illegible] to attach except the wires and poles. Harland has secured a verdict for $225,000 for the alleged rent of lines between Cleveland and Chicago, and this at[illegible] judgment. M. D.

St. Louis, Mo.

[illegible] has completed the [illegible] for 100 incandescent [illegible] of a 10 light arc [illegible] company. He [illegible]

[illegible] new station is [illegible] install 20,000 [illegible] meters on [illegible] basis.

[illegible]

[illegible] already been broken for this [illegible] will soon begin. B.

Indianapolis, Ind.

[illegible] Jenney Electric company [illegible] orders during the past week [illegible] Phillipsburg, Penn., 50 light arc apparatus [illegible] arc lights, necessary dynamos [illegible] Penn., 35 arc light outfit.

At [illegible] council and aldermanic committees appointed to investigate and draw up an ordinance [illegible] the council, regulating the change [illegible] the present mule car line on Illinois street from [illegible] to Crown Hill, a distance of something over [illegible] Manager Schaffer of the street car company stated that his company was willing to go ahead, provided the city met it half way. No report was agreed upon.

A resolution was adopted by the council Monday night authorizing the city attorney to draw up an ordinance, to be presented at next Monday night's session of the council, granting a franchise to an electrical street railway to construct a line from Crown Hill cemetery to Garfield Park, a distance of about seven miles. M.

THE ELECTRIC LIGHT.

An electric light plant is to be installed at Milford, Neb.

Americus, Ga., contemplates lighting its streets by electricity.

An electric light company has been organized at Berkeley, Va.

An electric light plant will be installed shortly at Chester, S. C.

An electric light plant is to be installed at Mount Sterling, Ky.

The Gadsden, Ala., Electric Light company will soon increase its plant.

The city council of Newton, Ga., is considering electric lighting for streets.

J. H. Blumenthal will introduce an electric light plant in Corpus Christi, Tex.

An electric light plant will soon be installed at Tybee Island, near Savannah, Ga.

A company has been organized to operate an electric light station at Elberton, Ark.

A company has been organized to operate an electric light station at Yorkville, S. C.

Albany, Ga., will soon be illuminated by electric lights, when a grand celebration will take place.

The State lunatic asylum at Columbus, S. C., will be lighted by the Westinghouse system hereafter.

The Nelsonville, O., Electric Light company has filed articles of incorporation; capital stock, $25,000.

The Citizens' Gas Light company of Jackson, Miss., will soon increase the capacity of its station.

An electric light company has been organized at Piedmont, W. Va., with a capital stock of $20,000.

A paper in Long Pine, Neb., says an electric light plant is one of the possibilities in the immediate future.

The Northwestern Incandescent Light company of Grand Forks, Dak., recently decided to enlarge its plant.

J. W. Neal, T. W. Crozier and others have been granted a franchise to operate an electric light plant in Roanoke, Va.

The East Lake Land company of Birmingham, Ala., has issued $100,000 bonds, and will install an electric light plant.

The California Electric Light company has placed another order for a 40 to 45 light 1,200 candle power Brush arc machine.

A franchise has been granted to an electric light company [illegible] A Thomson-Houston plant will be installed.

The Capital Electric Light company has been organized [illegible] Joseph Dahlgren, T. A. Atchison and [illegible]

[illegible] O'Brien of Boston has been appointed receiver [illegible] Electric Light company of that city, which [illegible] of the Supreme court.

[illegible] orders with the Brush [illegible] candle power arc [illegible] in Pennsylvania.

[illegible] company has been organized at Concord, [illegible] the commissioners to [illegible] franchise being [illegible]

[illegible] an electric light [illegible] The plant must be [illegible] city pays for four [illegible]

[illegible] company, of Chicago [illegible] to furnish elec[illegible] John [illegible]

[illegible] of the [illegible] Electric [illegible] The agent [illegible]

dered two Brush incandescent machines with capacity of 150 lamps each, together with lamps, etc., to be used in Wisconsin.

The city council of Shelbyville, Ind., has contracted with the Howe Electric Light & Power company for forty-eight arc lights, of 1400 candle power each, at $85 per light per annum, for a period of five years.

The Electric Light company at Chillicothe, O., recently placed an order with the Brush company for an arc light dynamo with capacity of from 40 to 45 lamps of 1,200 candle power each. Lamps were also ordered for the machine.

The electric light company, recently organized at Hagerstown, Md., has elected the following officers: President, C. E. G. McKee; secretary, Geo. W. Smith; treasurer, T. B. Cushwa. The company will probably secure the Schuyler plant now in operation there.

The Southern Electric company of Baltimore, Md., has been incorporated by Jas. F. Morrison, D. Howard Tuxworth, Frank S. Marr and others, for the manufacture of electrical machinery, erecting plants, constructing overhead and underground lines, etc. The capital stock is $100,000.

O. J. Lincoln and P. R. Hinds have petitioned the Santa Cruz trustees for an incandescent electric light franchise. They want to lease the city light plant for forty-five years, and offer to furnish forty arc lights free during the forty-five years. The city is now running its own arc plant, and may put in an incandescent plant.

The Fort Scott, Ark., Electric Light company has made a bid for a two years' contract, with the privilege of five years; not less than fifty arc lights, at $15 per month for two years, at $12.50 per month for all required over that number, or $10 per month for not less than fifty lights, and $9 for all over that number, on a five years' contract.

Among the recent sales of the Thomson-Houston company of Chicago are the following: Columbus, O., Electric Light & Power company, 50 arc lights, increase; Iowa City, Ia., 35 arc lights; Marceline, Mo., 35 arc lights; Tacoma, Wash. Ter., 50 arc lights; Sparta, Wis., 600 alternating incandescent lamps; Spache Milling company, Alton, Ill., 50 light incandescent plant for lighting their mills.

At the last meeting of the council of Phillipsburg a franchise was granted the Silvey Electric Light company of Lima, O., to erect and maintain poles in the streets and alleys of the borough, and the terms offered for a five years' contract were accepted. The company will put up a plant and carry out the contract if 600 incandescent lights and 10 arc lights in addition to the 25 guaranteed by the council, are subscribed for.

The Westinghouse Electric company, during the first half of the present month, received orders for alternating current apparatus aggregating 10,750 lights. These included initial orders from St. Joseph, Mo., 3,000 lights; Newburgh, N. Y., 1,500 lights; Decatur, Ill., 750 lights; Oxford, O., 1,000 lights and a 50-light Waterhouse arc outfit; Wyoming, O., 750 light; the Safety Light, Heat & Power company, New York, 3,000 lights; increase of existing plants in Washington, Pa., 750 lights. A year ago seventy-nine central stations were using or erecting Westinghouse alternating plants. On the 15th inst. the number had reached 160, with an aggregate capacity of 300,000 16-candle power lamps.

A peculiar boycott is at present being carried on in Danbury, Conn., in which the leading merchants and consumers of gas and electricity are arrayed against the only gas and electric light company of the place. The largest stores on the principal streets are illuminated only by dingy oil lamps suspended from the ceilings. The difficulty began when, several weeks ago, the gas and electric light company announced a marked increase in its rates. The larger consumers raised an objection, and set out to devise a means of avoiding the payment of the increased prices. The first step was to order the removal of the electric lamps and appliances from the stores, the merchants sign up a set of resolutions denouncing the action of the company. The company remained defiant, and the merchants' syndicate ordered the shutting off of gas and substituted oil without a murmur. They established a joint stock company of their own under the name of the Merchants' Electric Light company, and have applied to the legislature for a charter. The old company is making a strong fight against this proceeding, and until the matter is settled the merchants will burn kerosene.

The Westinghouse Electric company has begun an action in the United States court at Albany, N. Y., against the Manhattan Electric Light company of New York, which operates the Fort Wayne Jenney system, for alleged infringement of a patent just granted the United States Electric Lighting company on an important improvement in armatures made several years ago by Edward Weston of Newark, N. J. George Westinghouse, president of the Westinghouse Electric company, has issued the following notice: "The public are notified that from and after this date the unauthorized sale or use of dynamo-electric generators and motors provided with sectional armatures built up of iron plates which are separated by interposed insulating material, will be held to be in violation of Letters Patent Nos. 401,665 and 401,666, issued April 16, 1889, to the United States Electric Lighting company, assignee of the original inventor, Edward Weston of Newark, N. J. The claims of these patents broadly cover the core of an electric generator, subjected to inductive action when composed of alternate sections of magnetic and of insulating material in combination with the conductors wound thereupon. This notice does not apply to the sellers or users of dynamo-electric generators or electric motors which contain sectional armatures manufactured by the Edison Electric Light company, our licensees under these patents. All other parties are hereby warned against [illegible] selling or using the invention covered by the above mentioned letters patent."

THE ELECTRIC MOTOR.

An electric railway is contemplated at Athen[illegible] Ala.

It is stated that an electric road will probably be built at Keokuk, Ia.

The Vicksburg, Miss., Street Railway company has [illegible] cided to operate by electricity.

The proposed Walla Walla, W. T., street railroad will be equipped with electric motors.

The street car company of Charleston, [illegible], contemplates adopting electricity for its road.

The Raleigh, N. C., Street Railway company will use electricity as a motive power on its road.

The Queen City Electric Railway company has asked permission to construct a line in Dallas, Tex.

The Coliseum Street Railway company of New Orleans proposes to introduce the storage battery system.

The Americus, Ga., Street Railway company, recently organized, will build an electric road eight miles in length.

It is said that the Seattle electric railroad at one point has a grade of 11½ per cent. This is the longest electric railway in the northwest.

A local company has asked the city council of Wytheville, Va., for a franchise enabling them to operate an electric light plant and an electric railway.

The Thomson Houston company of Chicago reports an increasing demand for motors in Chicago. They sold ten motors last week for operating printing presses and coffee mills.

The Portland, Ore., city council has granted the Metropolitan Street Railway company a franchise to build an electric railway from the foot of Columbia street to the southern boundary of the city.

The Des Moines, Ia., Electric railway company recently ordered six new motor cars from the Thomson-Houston company of Chicago. The railway company expects to open four more miles of track shortly.

A dispatch from Adrian, Mich., says: The common council is holding nightly sessions now considering matters connected with the electric belt railway, which is ready to begin track laying as soon as grades can be established.

The Fort Worth, Tex., Loan & Construction company has purchased the street railway franchises at Gainesville, Tex., and will introduce an electric system. The same company will operate the San Antoine, Tex., street railway which it recently purchased, and will introduce an entirely new electric system.

The Thomson-Houston company of Chicago has just received an order from the Omaha Electric Railway company for ten 30-horse power double motor trucks and three 80 horse power generators. This makes twenty-six 30-horse power double motor trucks and six 80-horse power generators used on this road, of the Thomson-Houston pattern.

An Omaha paper says: At a meeting of directors of the Omaha Motor company, it was decided to purchase a 400-horse power engine in addition to the one of 250-horse power already ordered, and which will be here about May 15th. The purchase of twenty additional cars, and the expenditure of $50,000 additional for electric appliances, was also ordered. The company already has ordered twenty six cars which will bring the number up to forty-six. The amount previously expended for electrical appliances was $51,000. The officers estimate that the completion and improvement of their routes will necessitate an expenditure of half a million of dollars. W. L. Adams was made superintendent, and a house at the end of each line was ordered, so that early cars can start at the same hours from all points. The company now has a force of 2,000 men constantly at work on improvements. Aside from this number, it now requires 300 men to operate so much of the line as is now completed.

The Thomson-Houston company of Chicago has received the following complimentary letter from the Des Moines Electric company, in relation to the operation of the electric street railway built by the Thomson-Houston company in that city: "We have refrained from writing you fully concerning the operation of your system of electric street railway, for the reason that we desired to give it such a test as would forever remove any doubt as to its complete efficiency. This test has been given. Our lines present every obstacle to easy street car operation; we have two grades, each five per cent. and about 500 feet in length, with curves of not exceeding thirty-three feet in radius where the grade is three per cent. The cars mount these grades and round these curves with ease. Our open cars loaded with as high as 100 persons stop and start without difficulty on these grades and curves, and we have not yet seen the slightest indications of the lack of power in the motors. We are operating six and seven cars on our five miles of track with one 80-horse power generator, with a voltage of 500, and any speed can be made that is desired. The cars have been in operation without delay or suspension since the initial trip in December, and the commutators, with the use of non-sparking carbon brushes, do not show a particle of wear. The wooden trolley arm, with the self-adjustable traveler, will make any curve in the overhead wire at any speed at which the cars may be run. We consider that your motors will do everything which has been claimed for them by you, and feel justified in saying that the cost of operation per car is not one-half the cost of operating by horses, while each car makes at least ninety miles a day. We consider the operation of electric street cars, by your system, no more of an experiment than lighting [illegible] by the same method. [illegible] many people here [illegible] in a town [illegible] current was passing along in uninsulated [illegible] have subsided [illegible] employes [illegible] And even the [illegible] being [illegible] entered have [illegible] and were easily [illegible] months' [illegible] with the same [illegible] operated by electric power [illegible] economy, and to the entire satisfaction of an exacting public."

THE TELEPHONE.

The [illegible] Va., Telephone company has [illegible] incorporated, with $10 000 capital stock.

The Bell Telephone company has decided to bury its wires in the principal streets of Rochester, N. Y., and work will be begun immediately.

W. D. Sargent, general manager of the New York & New Jersey Telephone company, who has been appointed to take charge of the telephone exhibit at the Paris exposition, sailed on the "La Gascogne" April 13th. A number of his associates in the telephone field united in giving him a complimentary dinner at the Electric club of New York on the evening of the 11th inst.

The convention of the National Telephone association will commence in Minneapolis September 10th, at the West hotel. Negotiations are pending for a special vestibule train, with dining and other conveniences on board, to convey the delegates from the eastern states, which it is proposed shall run through without change, from New York to Minneapolis, on limited time.

The officials of the American Bell Telephone company appeared before the legislative committee on mercantile affairs at Boston April 18th and presented their petition, asking that they be allowed to increase their capital stock by $10,000,000. George O. Bruce conducted their case. He said the company had work which it was necessary to do, and the additional capital was asked for that purpose. The present capital, he said, was $10,000,000, and the company had established 721 exchanges, distributed all over the country, representing 170,000 miles of wire, over which an average of 1,055,000 messages were transmitted daily. It had been considered proper, in order fully to meet the requirements of the public, to ask for another $10,000,000 of capital, mainly for the purpose of perfecting the long distance system, by which a message could be sent as easily 800 miles as it formerly was to communicate over a distance of ten miles. In the three years ended January 1 the company had expended on the long distance system $2,337,856.31. The line between Boston and New York cost $683,795.76. In the next four years the company proposed to build a double line between Boston and Chicago, and in these four years it would have to expend $10,000,000 in construction. In addition the company's building in Boston when completed will have cost $800,000. Two millions in bonds mature in the next two years, and in the present year $600,000 will be expended upon the lines to Providence and to Washington.

THE TELEGRAPH.

The Western Union Telegraph company has petitioned to have the trial of the action of the commonwealth against it removed from Philadelphia.

A dispatch from Philadelphia dated April 16th, says: The suit of Frank J. Primrose to recover heavy damages from the Western Union Telegraph company rising from an excessive purchase of wool in June, 1887, owing to a mistake made by a receiving operator in a cipher message, ended in favor of the defendant in the United States Circuit court to-day. Judge Butler delivered an oral opinion upon the question whether a non-suit should be granted. He dwelt at length upon the agreement printed on the back of the telegraph blanks, which stipulates that upon the payment of an extra charge of half the price of sending a message it can be repeated, and the danger of mistakes avoided. This was not done in this instance. The decisions rendered in numerous similar cases were also referred to by the judge. Judge McKennan, who sat beside his colleague, concurred in the decision. Judge Butler instructed the jury to return a verdict for the Western Union, and this was done.

Miscellaneous Notes.

The Chicago Arc Light club will give a reception at 72 North Clark street April 30th.

The Ohio Electric Service company of Cincinnati has been incorporated, with $25,000 capital stock.

The Darche Electric company—capital, $10,000—has been incorporated at Chicago, to manufacture electric appliances and hardware specialties, and engage in electrical construction; incorporators, G. C. Darche, E. T. Darche and G. D. B. Dods.

The National Railway, Electric & Industrial Exposition association of St. Joseph, Mo., has filed articles of incorporation. The company has a capital of $1,000,000, and proposes to have an agency in every state and territory in the Union, and in foreign countries.

Harry A. Kinney gave an interesting lecture April 12th before the Y. M. C. A. of Omaha, on "Electricity; its Sources, Characteristics and Appliances." Mr. Kinney illustrated his lecture by a large number of experiments, obtaining current from a Pumpelly storage battery.

[illegible] Co. Da [illegible] Weir Frog c[illegible]

[illegible] of Washington, Ap[illegible] president of [illegible] into atmospheric electricity. These researches have been conducted by Prof. Mendenhall for several ye[illegible] when he was connected with the [illegible] tinued since his separation therefrom under the direct[illegible] the chief signal officer. The idea of making researches was to determine whether or not there was anything in the phenomena of atmospheric electricity [illegible] in making more certain the [illegible] bureau. Prof. Mendenhall reports as a result of his investigations many interesting facts, but [illegible] practical benefit to the signal service. The noticeable electrical phenomena, he said, are contemporaneous with the duration of storms, and valueless in the line of predictions.

Business Mention.

C. D. Shain of the Westinghouse Electric company will open the Cincinnati office on May 1st in the [illegible] building, 99 W Fourth street.

George Cutter, who has just opened an office of his own in Chicago for the sale of electric light specialties, has sold 500,000 feet of Simplex wire in the last three weeks. One of his friends remarked: "Mr. Cutter is as enthusiastic nowadays over business matters as he has been heretofore over scientific problems."

It is stated that the factory of the Sprague Electric Railway & Motor company is overcrowded with orders for motors, both for stationary and railway work. The large number of railroad companies which have ordered the new 30-horse power motor car equipment and improved Sprague motors, would have been sufficient alone to have kept the business of the Sprague company devoted exclusively to that branch of the electric power field. But the attention of the Sprague company has not been devoted entirely to this class of work. They have recently received a number of large orders for stationary motors, including one to operate a mill in Nebraska by electricity, using more than 100 horse power of motors, with the generating station more than three miles away. In addition to this order they have received a number of others for less individual capacity, but making a very large aggregate. Several other mills have ordered complete electrical equipments, and a large number of orders for stationary motors have been sent in from all directions.

Electrical Patents.

Issued April 16th, 1889.

401,332. Automatic Cut-out for Secondary Batteries. Stanley C. C. Currie, Philadelphia, Pa.

The invention consists essentially in combining the main circuit of a dynamo electric machine of an accumulator; a coil of comparatively thick wire influencing a magnet and an armature controlling the main circuit, but energized by a separate coil of comparatively fine wire in circuit with the dynamo.

Of the eight claims the fourth is given:

"The combination set forth, of the main circuit coil, the branch circuit coil coincident therewith, the permanent magnet and the [illegible] closed by the coils, and the main circuit switch controlled by the armature."

401,333. Pole or Tower. John W. [illegible], Ontario, Canada.

401,334. Telegraphy. Patrick B. De[illegible], N. Y.

The first and fifth claims are given:

"1. The combination of [illegible] end thereof, with which the [illegible] transmitting and receiving devices [illegible] line, and line opening devices [illegible] said devices consisting of sep[illegible] in the line, one of which is disconnected or insulated from the other and from each [illegible] are separated, and contact [illegible] by the relay, which momentarily [illegible] and leave the line open or [illegible] battery for a brief period after each [illegible] main circuit.

"5. The combination [illegible] way or intermediate stations [illegible] automatically connected [illegible] devices at each end of the [illegible] at each end of the [illegible] contacts [illegible] which is disconnected or insulated [illegible]

from earth when the contacts are separated, and contact separating devices controlled by the relay, which [illegible] and leave the [illegible] earth and battery [illegible] of the circuit.

[illegible] Hiram G. [illegible]

[illegible] A. Gildemeyer, [illegible]

[illegible] Magnetic Thermo- [illegible] N. Y.

[illegible] Galvanic Batteries. Chauncey V. Osborn, Chicago, Ill.

[illegible] with a weighted rod and rock shaft of a graduated scale, circuit wires, and [illegible] any one of [illegible] different rates of rupture."

[illegible] St. Petersburg, Russia.

Claim 1: "A rheostat comprising a holder or receiver, a conductive material capable of being compressed or compacted; and an adjustable metallic follower or piston arranged to operate upon said material, in combination with a support for the rheostat, consisting [illegible] strap of T shape, provided with a bearing for the piston rod in its vertical branch and with recesses in the outer edges of the horizontal branch or branches."

[illegible] Andrew W. Brown, New York, N. Y.

401,414. Process of Treating Magnetic Iron Ore. Gurdon Conkling, Glens Falls, N. Y.

Claim: "The process for treating magnetic iron ore, which consists in exposing the ore after having been crushed to the action of a succession of magnets of graduated intensity in relation to the mass exposed to their action, and finally collecting the iron particles attracted by the several magnets in separate heaps or receptacles."

401,415. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

401,416. Combined Lamp Shade or Reflector and Guard. Charles A. Cooley, Montreal Quebec, Canada.

401,417. Electric Lantern. Charles W. Cox and Thomas E. Van Dyke, Philadelphia, Pa.

401,428. Process of Determining the Center of Attraction in Polarized Bodies. Adolphus Gipperich, Richmond, Va.

The process consists in neutralizing such bodies against the influence of terrestrial magnetism, by loading the poles of the body.

Claim 1: "The mode or process of determining the center of attraction or point of leverage in a polarized body, which consists in neutralizing such body against the influence of terrestrial magnetism, loading the poles of the body with a substance capable of being attracted and held thereby, removing the load from one of the poles, weighing such load, and suspending an equal weight from said pole at a point where it will equilibrate the load at the opposite pole."

401,434. Incandescent Lamp. Hermann Lemp and [illegible] Hartford, Conn.

[illegible] in wire for an incandescent electric lamp and a conductor flattened through the [illegible] glass of the globe, the flattened [illegible]

[illegible] John S. Sellon, Hatton Gardens County of Middlesex, England.

The claim reads: "In a secondary battery, a plate [illegible] conducting material containing a series of uniform holes or perforations separated and surrounded [illegible] having a double-bevel cross section so arranged that the areas at the surfaces are substantially equal, but greater than the [illegible] with an active material located within such holes or perforations in the form of a series of equal truncated cones [illegible]

[illegible] Theodore [illegible]

[illegible] Railway System [illegible]

[illegible] are given [illegible] prepared [illegible] terminals con- [illegible]

the arc lamps, the shunt circuit or circuits being taken around less than the total number of arc lamps in circuit.

"2. In a system of electric lighting, the combination of a circuit containing arc lamps arranged in series with a number of cross or multiple arc circuits taken from different points between the arc lamps and incandescent electric lamps located in said independent cross circuits and adjusted by number and capacity for the different electromotive forces existing at said several cross circuits."

401,498. Wiring Structures for Electric Lighting. Edward H. Johnson and Edwin T. Greenfield, New York, N. Y.

The object of the invention is to facilitate wiring houses and other structures for electric lighting so that any wire in the building may be readily removed and replaced by another when necessary, and also to furnish protection from fire due to crosses or leakage on the wires. Claim 2 is appended:

"In house-wiring for electric light, the combination, with the building or structure, of a system of insulating pipes extending throughout the same, and comprising main and branch pipes, a pair of wires in each pipe, insulated from each other and placed in close proximity to each other, and each forming one side of an electric lighting circuit, and safety catches interpolated in the circuit."

401,515. Underground Conduit for Electrical Railways. Fred H. Read, Jersey City, N. J.

401,520. Method of Operating Electro-Magnetic Motors. Nikola Tesla, New York, N. Y.

All the claims but the last are given:

"Claim.—1. The method of operating an alternating current motor herein described by first progressively shifting or rotating its poles or points of greatest attraction, and then, when the motor has attained a given speed, alternating the said poles.

"2. The method of operating an electro-magnetic motor, which consists in passing through independent energizing circuits of the motor alternating currents differing in phase and then, when the motor has attained a given speed, alternating currents coinciding in phase.

"3. The method of operating an electro-magnetic motor herein described, which consists in starting the motor by passing alternating currents differing in phase through independent energizing circuits, and then, when the motor has attained a given speed, joining the energizing circuits in series and passing an alternating current through the same."

401,521. Indicating Device for Charging Furnaces. Edward Walsh, jr., St. Louis, Mo.

"Claim.—2. In an indicating device for furnaces, the combination, with the magazine of a pivoted lever, one arm of which projects into the magazine and is operated upon by the material therein, an electro-magnet operating upon the other arm of the lever, and an electric alarm circuit in which the electro magnet is located."

401,527. Cut-Out for Incandescent Electric Lamps. Edwin R. Whitney, St. Johnsbury, Vt.

Claim 1 is as follows:—"In combination with an incandescent electric lamp, an independent glass lamp bulb, contact pieces, and carbons of a higher resistance than that of the filament in the lamp proper, inclosed in such independent bulb, connections of carbons and contact pieces with main wires, a wire inclosed in and suspended from top of said independent bulb, a fusible strip forming part of such wire, to which said carbons are connected, and a drop-plug carried by said wire and adapted when dropped to rest on said contact pieces and form a circuit through them."

401,580. Method of Exhausting Electric Lamp Bulbs. James W. Packard, New York, N. Y.

401,582. Valve Actuating Apparatus. James W. Packard, New York, N. Y.

The invention consists in an automatically operated valve for attachment to mercury air pumps.

"Claim—2. The combination, with a two-way cock which connects an air tight chamber alternately with the atmosphere and with a vacuum pump, of an electrical switch, a pressure gauge connected with the electrical switch and operated by the varying pressures in said air-tight chamber, opposing magnets alternately excited by currents under control of the said switch, continuously and oppositely revolving pulley wheels, and clutches operated by the opposing magnets which throw the two-way cock alternately into gear with one or the other of the oppositely revolving pulley wheels."

[illegible] Electric Alarm Advance Car. Harry Riesenberg, St. Louis, Mo.

[illegible] Manufacture of Carbon Filaments. Edward P. Thompson, [illegible] N. J.

[illegible] consists in [illegible] washing the carbon- [illegible] gas while it is incandescent, [illegible] particles while it is being so washed by means of a static current or charge; [illegible] under torsional strain, [illegible] time under tension, [illegible] permanent set to its [illegible] up and forming the [illegible] The first and last [illegible]

[illegible] filaments, which con- [illegible] current of inert gas, [illegible] so washed, and in [illegible] inert while being [illegible]

[illegible] filament for incan- [illegible] with an in- [illegible] the filament's [illegible]

revolving support for one of the clamps, an armature carried thereby, an electro-magnet outside of said case for revolving the armature, and a spring acting in opposition to the longitudinal pull of said electro-magnet."

401,607. Manufacture of Incandescing Carbon Filaments. Edward P. Thompson, Elizabeth, N. J.

The object of the invention is to provide means for expelling all the oxygen which may be absorbed by filaments and by the moulds carrying them after the the filaments are partially carbonized by acids and before they are subjected to heat for completing the carbonization. The claim follows: The process of preparing filaments for incandescent electric lamps, which consists in winding the filaments upon carbon blocks, displacing the occluded gases in the blocks and filaments, filling the pores of the blocks and filaments with an inert fluid, and carbonizing the filaments."

401,608. Distribution of Electric Currents. Elihu Thomson, Lynn, Mass. The first and last claims are appended

"1. The combination, in a system of electric distribution, of a main or principal circuit, a local or independent circuit, interposed apparatus for transforming the electric energy in the main into electric energy in the local without contact between the circuits, a fusible plug or safety strip in the connection from the main to said apparatus, and means, as described, for rupturing an arc at the fusible plug.

"7. The combination of a furnace structure, a main boiler resting on the front furnace wall, the columns having a girder provided with pendent bolts by which the rear end of the main boiler is suspended."

401,616. System of Electric Locomotion. Frank Wheeler, Meriden, Conn.

401,617. Electrical Measurement Apparatus. Anthony C. White, Boston, Mass.

The last claim follows: "5. In an electrical measurement apparatus, the combination of a direct reading voltmeter, an adjustable shunt therefor containing a series of resistances in geometrical progression with the number ten for a ratio, an additional circuit terminal electrically connected with the said shunt circuit, and a high resistance included between the said shunt and the said extra terminal, the said high resistance having such a value that when added to a determined one of the shunt resistances the sum shall be one thousand ohms, or a greater or less number in the same geometrical progression, and having the same ratio."

401,631. Forming Curved Electrotypes. Gilbert H. Benedict, Ellenville, and Patrick M. Furlong, Troy, N. Y.

401,632. Dynamo Armature. Carl O. C. Billberg, Philadelphia, Pa.

The invention consists of means of avoiding the production of eddy currents and retain the polar projections or teeth on the armature core arc.

The claims are: "Claim 1. An armature core for a dynamo-electric machine or electric motor, having an iron core with polar projections or teeth, and a divided iron sheath around the outside of the armature throughout the length or part of the length of the polar projections.

"2. An armature for a dynamo-electric machine or electric motor, having a divided iron core with polar projections and a divided iron sheath composed of iron wire wrapped around the armature circumferentially throughout the length or part of the length of the polar projections."

401,639. Process of Electric Welding. Charles L. Coffin, Detroit, Mich.

The invention consists in submitting the joint to be welded simultaneously to the action of manifold arcs instead of a single arc.

401,646. Incandescing Electric Lamp. Thomas A. Edison, Menlo Park, N. J.

"Claim. An exhausted and sealed incandescent electric lamp provided with a tube or vessel containing a gas absorbing material such as charcoal—such tube or vessel being connected with the exhausted chamber of the lamp, and embedded in the base of the lamp."

401,664. Railway Track-Instrument. George C. Steenbergh, Syracuse, N. Y.

401,668. Dynamo Electric Machine. Edward Weston, Newark, N. J.

The invention relates to armatures of the class which are wound longitudinally and caused to move in a magnetic field at right angles to the lines of force and consists in the combination, with the shaft, of a cylinder or hub of insulating material secured thereon, iron plates or rings strung over said hub, and plates or sheets of insulating material interposed between said rings.

401,669. Dynamo Electric Machine. Edward Weston, Newark, N. J.

The last claim is appended: "3. A core for electrical generators operating by inductive action, composed of iron sections, plates or disks, with interposed plates or sections of insulating material, in combination with means for binding and holding the same together and insulated coils wound thereon at right angles to the planes of lines of the insulating sections."

401,692. Electro-Therapeutic Spectacles. Caspar Brust, Munich, Germany.

401,[illegible]. Magnetic Ore Separator. Chandler C. Coats, Newark, N. J.

The invention relates to that class of ore separators in which the revolving wheel carrying the magnets or electro magnets is combined with a belt passing around the wheel, and also around another non-magnetic wheel or drum, so that the attracted particles of metal are carried off.

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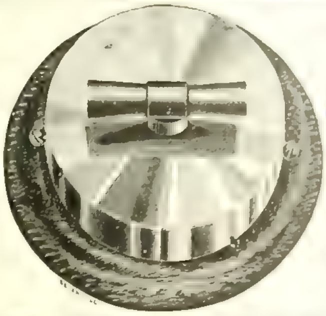

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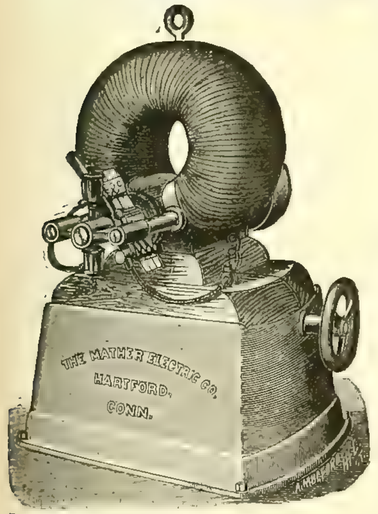

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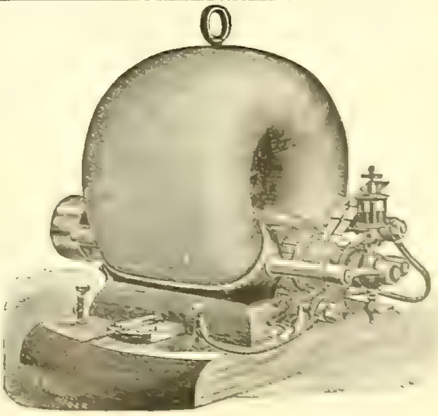

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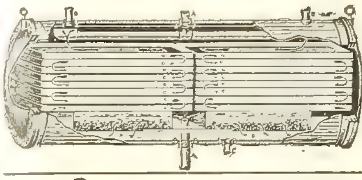

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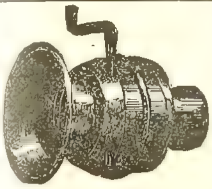

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American Electrical Works,

PROVIDENCE, R. I.,

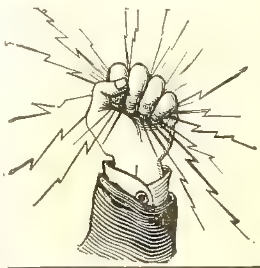
EXCLUSIVE MANUFACTURERS OF THE

FARADAY CABLE

—FOR—

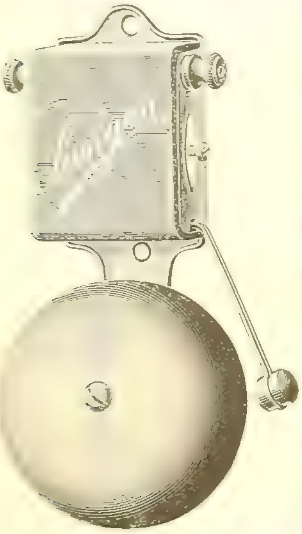
Telegraph, Telephone and lectric Light.

Highest Insulation and Lowest Inductive Capacity of any Cable in the Market.



New York Office, 18 Cortlandt Street.

P. C. ACKERMAN, Agent.



R. EDWARDS. A. LUNGEN.

EDWARDS & CO.,

Manufacturing -:- Electricians,

PATENT ELECTRIC BELLS,
AUTOMATIC BURGLAR ALARMS,
DOOR OPENERS,
ELECTRIC ANNUNCIATORS,
THERMOSTATS, GAS LIGHTING APPARATUS, ETC., ETC.

Office and Factory: 4th Ave. & 144th St., New York.
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THE LUNGEN BELL.

(PATENTED.)

ENTIRELY NEW IN CONSTRUCTION.

The Base and Cover are stamped, and having ribbed edges are strong, light and compact. Every piece is interchangeable, special machinery being used in its manufacture.

The Armature, Hammer and its Rod and Adjusting Springs are combined so that they cannot work loose. The Adjusting Screw is held firmly by spring nut, and always remains as set. The base and metal parts are Nickel Plated. The Cover is made to spring on and requires no fastening. The hammer rod passes through the side of base, thereby filling opening, making it Dust and Insect Proof

Electric Light Repairing, General Machine Job-Work, Pattern Making, Etc., Etc.

FORÉE BAIN,

ELECTRICAL AND MECHANICAL ENGINEER, DESIGNER, MANUFACTURER.

Office and Works: 76 MARKET ST., CHICAGO.

STANDARD ELECTRICAL TEST INSTRUMENTS,

Ammeters and Voltmeters of all kinds.

AYRTON & PERRY NEW SPRING.

CARPENTIER, HARTMANN & CO.,

Galvanometers, Bridges and Rheostats by all the Prominent Makers.

CALL AND EXAMINE.

James W. Queen & Co.

924 Chestnut St., Philadelphia.

W. S. TURNER. J. LESTER WOODBRIDGE.

WOODBRIDGE AND TURNER,

ELECTRICAL ENGINEERS AND CONTRACTORS.

ELECTRIC Light and Power Stations. Railway Construction. Light Wiring.

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THE EDISON MACHINE WORKS,

SCHENECTADY, N. Y.,

—MANUFACTURERS OF—

Insulated Wires, Flexible Cords and Cables for Telephone, Telegraph

—AND—

ELECTRIC LIGHT.

JAMES F. KELLY, General Sales Agent, 19 Dey Street, New York.

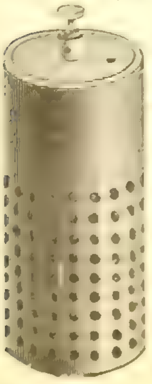
C. M. STONE,

Electrician, Contractor and Electric Light Inspector.

... Pacific Ave., ... Chicago Ill.

... a specialty. Existing ...

THE NATIONAL GALVANIC BATTERY



UNEQUALED FOR BELLS, TELEPHONES, GAS LIGHTING, ETC.

POROUS CUP.

... THE NATIONAL GALVANIC BATTERY CO ... CINCINNATI, O. ... NEW YORK.

Russell & Co.

MASSILLON, OHIO,

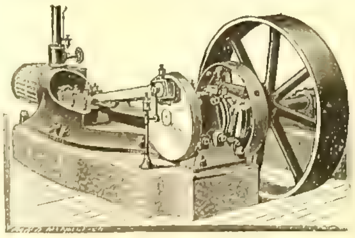
BUILDERS OF

AUTOMATIC ENGINES

BOILERS, ETC.

Complete Power Plants Furnished and Erected.

SEND FOR CATALOGUE.



GEO. H. BLISS,

ELECTRICAL EXPERT

DEALER IN	EXPLOITER OF
Electrical Securities.	Electrical Inventions.

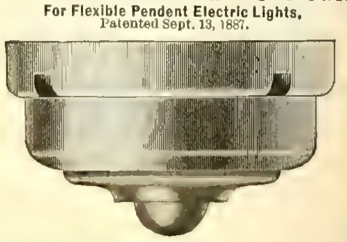
Rooms 70, 71 and 72 Temple Court,

225 DEARBORN STREET. CHICAGO, ILL.

THE STODDARD PATENT

Combined Rosette and Cut-Out.

For Flexible Pendent Electric Lights.
Patented Sept. 13, 1887.



These Cut-outs present a neat and artistic appearance, and while others may cost less, they require more time to install. It is found in practice about three to one, i. e., while a workman places twenty ordinary Cut-outs he can place sixty of these, thus making a saving of two-thirds the cost of labor. This would represent a saving of two dollars per day on each workman employed at three dollars per day. This adds ten cents to the cost of each of the cheaper Cut-outs for extra labor alone, while the advantage of having sixty lights provided for in the time but twenty are ready for use, is oftimes of vital importance.

Again, extra Base Blocks or Rosettes are generally required for other Cut-outs.

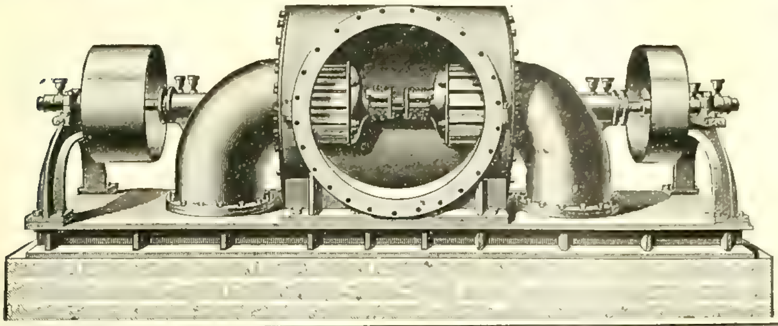
A continuing saving in matter of renewals, repairs and replacing fusible strips, all go to make up an aggregation of advantages, which has induced some users to state that they "prefer the Stoddard Cut-outs at their price, as against any other at less price."

MANUFACTURED BY THE

MARKLE ENGINEERING CO., Detroit, Mich.

For Sale by all Electrical Supply Companies

VICTOR TURBINE WATER WHEEL



The attention [illegible] COMPANIES [illegible] CELEBRATED WATER WHEEL [illegible] on account of its **remarkably steady motion, high Speed and great Efficiency,** [illegible] **large Capacity.** [illegible] diameter, being **double** [illegible] **Power** [illegible] number of the [illegible] real use of water [illegible] producing [illegible] full effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal 'Victor' is highly recommended, [illegible] and it can be [illegible] Dynamo.

The accompanying [illegible] represents a pair of [illegible] **VICTOR TURBINES** arranged [illegible] horizontal shaft, with [illegible] Tubes, End Bearings [illegible] and Driving Pulley [illegible] a substantial cast iron [illegible] strictly first-class in every particular. We are now prepared to furn[illegible] Turbines, either single or in pairs on horizontal shafts, and where the [illegible] admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

HOLMES, BOOTH & HAYDENS,

FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

BARE AND INSULATED WIRE.

Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE MARK "K.K." **PATENT "K. K." LINE WIRE** TRADE MARK "K.K."

For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

AGENTS FOR THE WASHINGTON CARBON CO., CARBONS FOR ARC LIGHTING.

J. L. BARCLAY, Selling Agent, THE ROOKERY, CHICAGO, ILL.

THOS. L. SCOVILL, New York Agent, 25 PARK PLACE, NEW YORK.

OKONITE TRADE MARK

SOUTHERN ELECTRICAL SUPPLY COMPANY,

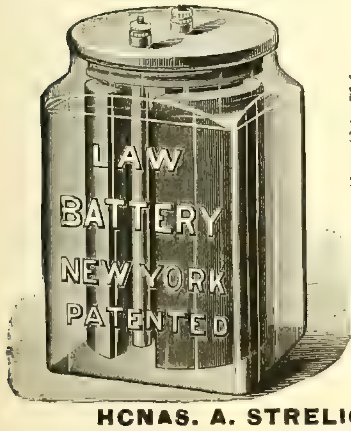
310 N. THIRD ST., SAINT LOUIS, MO.

ELECTRICAL SUPPLIES OF ALL KINDS AT BOTTOM FIGURES.

Okonite Wires, Cables, and Tubing, Weatherproof Line Wires, Manson and Okonite Tapes.

IT PAYS TO GET THE BEST. TRY US.

THE LAW BATTERY.



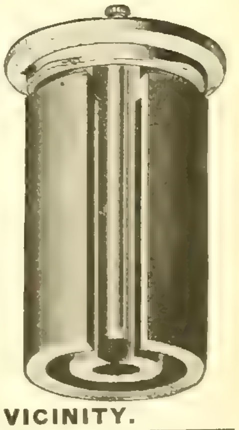
SIZE OVER ALL, 4¼×4¼×7½.

FOR ALL CLASSES OF OPEN CIRCUIT WORK.

In the latest form the negative element is a ***Double Cylinder, one within the other,*** having more surface and quantity than any other negative element in the market. Its efficiency and durability surpass all its rivals, and ***it is guaranteed for ten years.*** As now made both elements are secured wholly beneath the cover, instead of passing through the cover, as heretofore. The cover is of blue glass and locks tight to the jar, absolutely preventing evaporation of water and creeping of salts. Both binding posts are permanently attached to cover, and thoroughly protected against corrosion.

THESE ARE DECIDED IMPROVEMENTS.

Do not be so foolish as to buy a Prism, Porous Cup, or other perishable negative element battery, when one can be had which is ***PRACTICALLY EVERLASTING.*** And do not waste money by experimenting with any of the numerous new and untried batteries which are constantly coming and going, but buy the "Law," which ***has stood the test of eight years.***



LAW TELEPHONE CO., 112 Liberty St., NEW YORK.

Sole Agent for the Pacific Coast: GEO. L. HENZEL, San Francisco, Cal.

HCNAS. A. STRELICER & CO., DETRO.T, MICH., SOLE AGENCY FOR DETROIT AND VICINITY.

THIS "OKONITE" BOY

Can afford to smile at his competitors when he thinks of the immense advantage Okonite has in the race for perfect insulation for all kinds of Electric Conductors.

A FULL STOCK ALWAYS ON HAND.

CENTRAL ELECTRIC CO., 42 La Salle Street, CHICAGO.

FISHER-RAE ELECTRIC RAILWAY SYSTEM

For Street and Suburban Traffic.

Embraces new and valuable improvements which are requisite to economical operation, and high efficiency. The

ONLY SUCCESSFUL SYSTEM USING UNDERGROUND CONDUCTORS.

8 MILES OF CONDUIT IN ONE ROAD AT SAN JOSE, CAL.

Overhead Conductors.

IMPROVED TROLLEY AND TROLLEY SUPPORT line of neatest design. Avoids "flashing" at wheel or line contact.

The Fisher-Rae Electric Railway System

Contains new features that will commend it to the careful attention of Street Railway Managers looking for reliable, easily operated and efficient electrical apparatus, designed to stand the test of work.

The Fisher-Rae System

Can be placed upon existing roads without alteration of track or road-bed, and upon cars in use without interruption to traffic of road.

POINTS OF SUPERIORITY.

A SINGLE MOTOR GEARED TO BOTH AXLES WITH IMPROVED NOISELESS GEAR.

FLEXIBILITY BETWEEN MOTOR AND CAR AXLES, INSURING CLOSE MESH AND PREVENTING BREAKING FROM SUDDEN STRAINS.

The use where desirable of a separate motor truck, making a six wheel car, securing greater comfort to passengers; motor trucks easily and quickly detachable, enabling change of motors from closed to open cars.

CORRESPONDENCE solicited, estimates furnished, and references given to important roads now in successful operation.

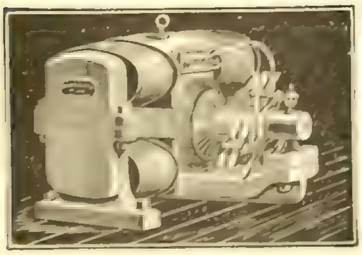
DETROIT ELECTRICAL WORKS,

7th and Woodbridge Streets, DETROIT, MICH.

Binders FOR THE Western Electrician **$1.00.**

I. W. COLBURN & CO.,

174 Main St., FITCHBURG, MASS.



Machines for Arc and Incandescent Electric Lighting, Electro Plating and Experimental Use.

[illegible]

Axo Battery Complete.

THE FIRST REAL IMPROVEMENT IN

POROUS CUP BATTERIES

Since the Invention of the Leclanche.

TRADE AXO MARK

Send for Circular of the Axo Battery.

THE LECLANCHE BATTERY CO.,

149 West 18th St., New York.

Porous Cup Alone.

THE JULIEN ELECTRIC

TRACTION COMPANY,

PRINCIPAL OFFICE, 120 BROADWAY, NEW YORK.

NEW YORK, APRIL 13, 1889.

DEAR SIR:—

We beg to call your attention to the present state of our system of Traction on Fourth and Madison Avenues in this city.

The last car which we put into actual passenger service (Car No. 7), and which is the standard type of car that we have finally adopted, is making five round trips per day between Eighty-sixth Street and Madison Avenue and the Postoffice, or 57½ miles daily. This is a car day's work on that line.

During the past forty (40) days its receipts in cash have been $998.10, exclusive of 998 transfers, for which it gets no credit; this is at the rate per annum of ***$9,106.75***

The average earnings of horse cars on the same line are ***6,387.50***

Difference in favor of the Julien System ***$2,719.25***

Deducting from gross earnings $4.00 a day for driver and conductor, and $3.60 per day for motive power, wear and tear, and royalty, would leave, per annum ***6,332.75***

Further deducting 6 per cent. interest on $6,000 (cost of the car with battery-racks, stationary motors, switches, etc.), ... ***360.00***

Leaves net earnings ***$5,972.75***

These net earnings will more than pay the entire cost of the car and its equipment at the end of the first year.

During the time the car has been in operation neither the batteries nor the motors have required attention nor the expenditure of one dollar for repairs or renewals. Even the brushes have not been changed, nor do they show any wear.

Car No. 1 on Fourth Avenue line commenced service on September 3d ultimo, and on April 8th her batteries were examined for the first time. They had not in this period been lifted from the cells to be cleaned or inspected. They were found to be in as good condition as when they were put in service—not a single plate in the whole battery showing any wear, injury or depreciation.

At one time it was thought that the handling of the batteries in our system of traction would be a serious obstacle, but this Company has now a battery shifting device whereby, in the length of a car body and on either side of the pit over which the car stands in the station, sufficient batteries are stored and manipulated to do the work of one hundred and thirty-five horses. The racks which contain the batteries and the hoists, which are run by two small stationary motors, do not, in all, cover as many cubic feet as two sixteen-foot cars. By aid of this device the batteries are changed in less than three minutes. In actual time, less than five minutes are required to inspect the car thoroughly, and change the battery.

An additional and important feature of this system is that a street railway need no longer have its own generating machinery, as must be the case with cables, over-head wires, and conduit systems. In every town and city where there is a central lighting station, power for charging the batteries may be purchased for about two cents per horse-power. So that the plant of our system will be reduced to the simple devices of one battery-rack, as above described, for each set of fifteen cars and switch-boards for governing the distribution of the current. Can anything be more simple?

The cost of motive power for a car day of sixty miles we estimate at $3.10. By motive power, we mean cost of energy at two cents per horse-power, and $700 per annum for maintenance of batteries and motor. These figures are the result of our present experience. To those who may think two cents per horse-power is a low estimate, we may say that we have offers from electric companies to furnish power at that figure. Indeed, it is furnished for less in some cases.

We guarantee our cars to do efficient service, and we will agree to maintain motors and batteries for a fixed annual sum.

Our new cars, thirty of which are now under construction by the Stephenson Company, will weigh but a fraction over six tons, or, in other words, but little more than the cars of the overhead system.

The following is a statement of mileage, passengers carried, etc.:

Record of Julien Storage Battery Cars on New York & Harlem Railroad City Lines, New York City, to March 31, 1889, inclusive.

Number of Car.	Miles Run.	Passengers Carried.
1	3,057½	27,076
2	1,276½	11,097
3	1,922½	16,040
7	1,875½	16,782

RECORD OF CAR NO. 7.

This new car was put into regular service on February 23, 1889, and has since been run on a special schedule of 57½ miles per diem, exclusive of Sundays.

Date.	Passengers.	Transfers.	Mileage.	Trips.	Cash.	Remarks.
April 1	445	26	57½	5	$22 25	Rain
" 2	520	34	57½	5	26 00	Fair
" 3	537	26	57½	5	26 85	"
" 4	517	13	57½	5	25 85	"
" 5	570	8	57½	5	28 50	"
" 6	554	48	57½	5	27 70	"
" 7	Sunday					
" 8	536	26	57½	5	26 80	"
" 9	529	26	57½	5	26 45	"
" 10	561	13	57½	5	28 05	"
" 11	594	33	57½	5	29 70	"
" 12	533	15	57½	5	26 65	Rain

THE JULIEN ELECTRIC TRACTION CO.,

120 BROADWAY, - - - NEW YORK.

THE WESTINGHOUSE ELECTRIC CO.,

LESSEE OF

THE UNITED STATES ELECTRIC LIGHTING CO.

SPECIAL NOTICE.

The public are notified, that from and after this date, the unauthorized sale or use of **Dynamo-Electric Generators and Electric Motors,** provided with **sectional armatures,** built up of **iron plates** which are separated by interposed **insulating material,** will be held to be in violation of

Letters Patent Nos. 401,668 and 401,669,
Issued April 16, 1889, to
THE UNITED STATES ELECTRIC LIGHTING CO.,

Assignee of the original inventor, Edward Weston, of Newark, N. J.

The claims of these patents broadly cover the **core of an electric generator** subjected to inductive action, when composed of **alternate sections** of **magnetic** and of **insulating material,** in combination with the conductors wound thereupon.

This notice does not apply to the sellers or users of

DYNAMO-ELECTRIC GENERATORS OR ELECTRIC MOTORS,

which embody sectional armatures manufactured by The Edison Electric Light Company, our licensee under these patents.

All other parties are hereby warned against making, selling or using the invention covered by the above mentioned Letters Patent.

THE WESTINGHOUSE ELECTRIC COMPANY,

April 16, 1889. Geo. Westinghouse, Jr., President.

WHO IS

The Pioneer in the Development of the Incandescent Electric Light System?

FACTS OF THE PRESENT CONTROVERSY.

THE NATIONAL ELECTRIC MANUF'G CO.

HOLDS THE KEY TO THE SITUATION

BEWARE OF IMPOSTORS.

"SUUM CUIQUE"

TO USERS OF ELECTRIC LIGHT APPARATUS:

The Edison and Sawyer-Man Electric Light Companies have recently deluged the country with circular letters and bombastic advertisements, setting forth that they have patents, which cover the fundamental principles of electric lighting; and that their patents have been sustained in the Supreme Court giving the exclusive right to manufacture and operate incandescent lamps. Nothing could be more misleading than such statements.

Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simple a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

This company takes the position: First, to defend the users of its apparatus against loss accruing from its use; second, to vigorously and determinedly prosecute Walter K. Freeman's claims for patents covering these inventions.

Our apparatus is of the highest efficiency—mechanically and electrically. We are prepared to guarantee its operation and defend our customers.

We are in this business on a business basis, for a manufacturer's profit; having all modern facilities for the production of first class apparatus. We solicit the patronage of electric light users, believing we can furnish the best.

OUR Dynamos, Lamps, and Converters are guaranteed to be the most perfect, mechanically and electrically, in the world. Our prices are low. We protect our purchasers as no other company CAN.

GET THE BEST. *Representatives wanted in every State in the Union.* GET THE CHEAPEST.

NATIONAL ELECTRIC MFG. CO., Eau Claire, Wis., U. S. A.

WOODWARD ELECTRICAL CO.,

BOARD OF DIRECTORS.

G. H. GALE, PRESIDENT.
[illegible]
H. H. HUMPHREY, TREASURER.

GEN. R. A. ALGER. G. H. GALE. S. A. PLUMMER. E. C. BROWN. T. WILLIAMSON. F. B. TROUT. C. A. WARREN. C. H. THOMPSON. H. H. HUMPHREY.

THOMAS WILLIAMSON, SECRETARY.
FRANK B. TROUT, SUPERINTENDENT.

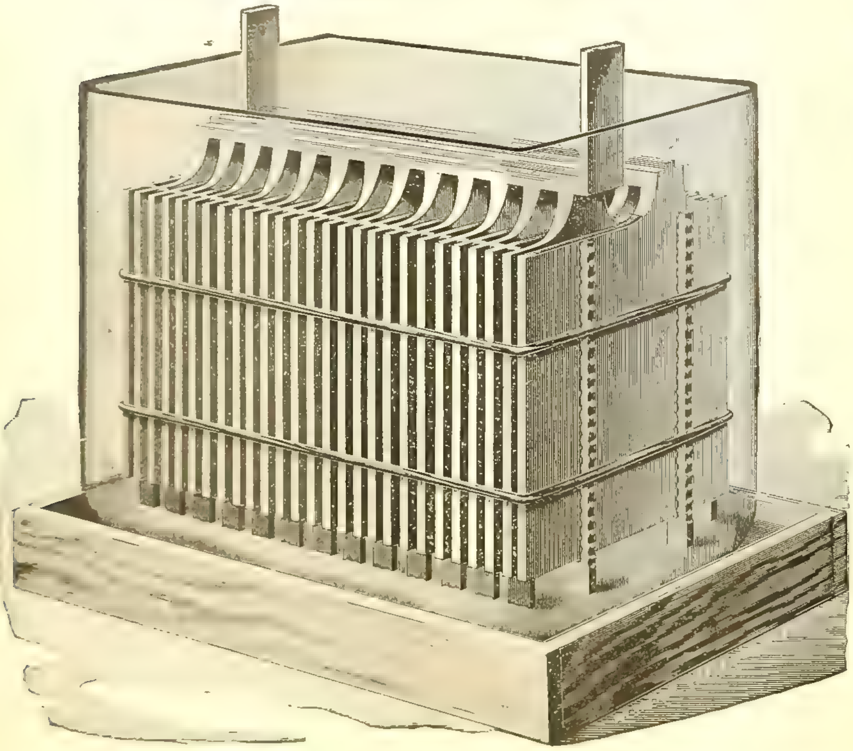
A SUCCESSFUL SECONDARY BATTERY AT LAST.

DETROIT STORAGE BATTERY.

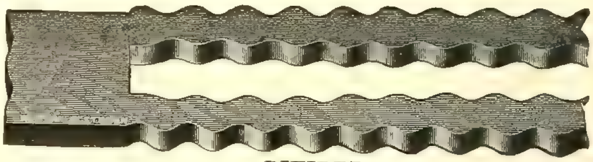
After careful IMPROVEMENTS in construction, has now been found to be THOROUGHLY RELIABLE and DURABLE, and is, owing to its design, PECULIARLY ADAPTED to many uses in which other types of batteries have failed.

SPECIALLY ADAPTED TO

Central Station Lighting, Street Cars, Burglar Alarms, Driving Ventilating Fans, Sewing Machines, Etc., Steadying Lights, Operating Signal Bells on Cars, Propelling Boats, Isolated Lighting, Auxiliary Central Station Work, Medical Purposes, Running of Small Motors.



BATTERY.



DIVIDER.

SECTION OF BATTERY PLATE.

THE Detroit Storage Battery,

MANUFACTURED UNDER PATENTS GRANTED TO C. H. THOMSON WHICH HAVE BEEN DULY ASSIGNED TO THIS COMPANY,

Is positively the only Secondary Battery which will not Buckle, or which will withstand uninjured the Highest Rates of Discharge.

THE ONLY SUCCESSFUL STORAGE BATTERY

IS MANUFACTURED AND FOR SALE BY:

The Woodward Electrical Co.

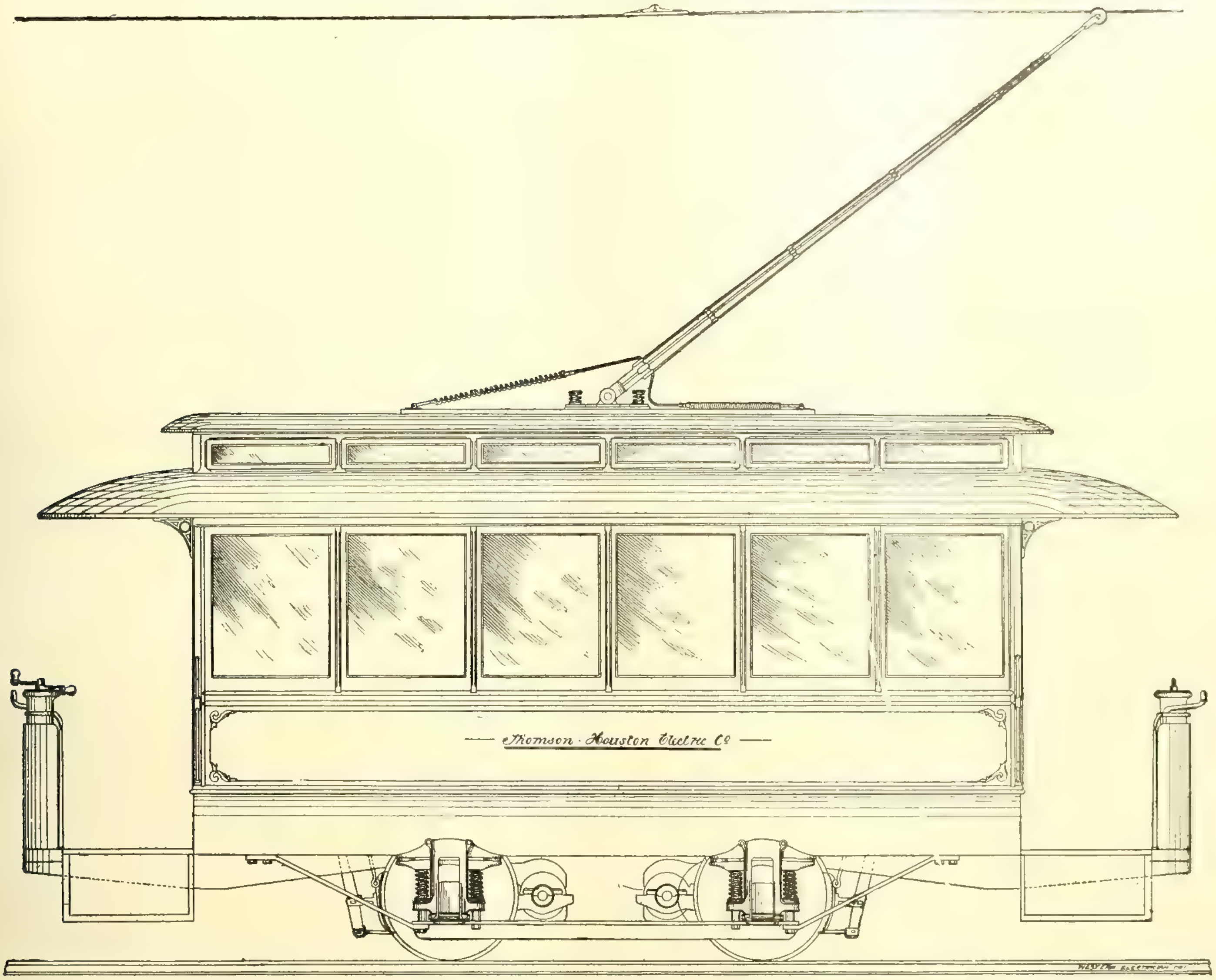
DETROIT, MICH.

OFFICES:
69 Griswold St., Campau Building.

FACTORY:
Corner 13th and Howard Streets.

F. B. TROUT, General Manager.

The Thomson-Houston Electric Railway System.



Twenty-six Roads in Daily Operation, and Sixteen Now in Process of Construction Under the Thomson-Houston Patents.

ALL MATERIAL IS NOW MANUFACTURED AT THE FACTORY AT LYNN, MASS., THE LARGEST AND BEST EQUIPPED ELECTRIC FACTORY IN THE WORLD.

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car, and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Thomson-Houston patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

MOTORS AND ELECTRICAL EQUIPMENTS FURNISHED FOR MINING AND OTHER SPECIAL WORK.

For Full Information and Estimates Address the

THOMSON-HOUSTON ELECTRIC COMPANY,

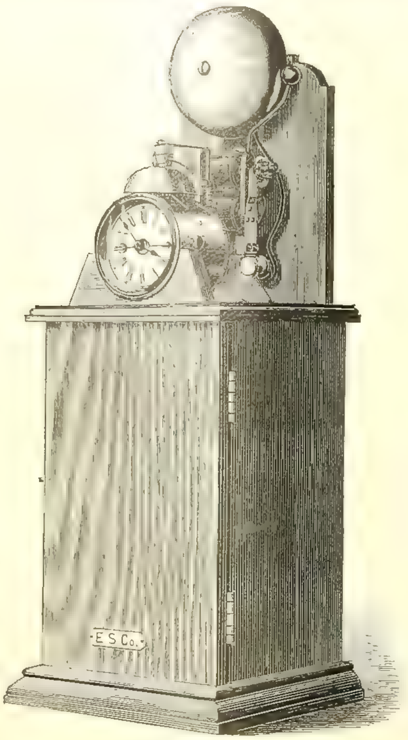
620 ATLANTIC AVE., BOSTON, MASS. 148 MICHIGAN AVE., CHICAGO, ILL.

THE ELECTRICAL SUPPLY CO.

THE SURE CALL ELECTRIC ALARM.

SOMETHING NEW AND SOMETHING NOVEL, NEVER FAILS TO RING.

FIT FOR PALACE OR FOR HOVEL. ERGO: "JUST THE THING."



No. 2825.

PAT.—GOOD MORNIN,' MIKE. YOU'RE LATE THIS MORNIN' AGAIN.
MIKE.—I AM THAT! I OVERSLEPT MESELF.
PAT.—BEGORRA, YOU'LL BE LATE AT YOUR OWN FUNERAL SOME DAY.
MIKE.—I WILL NOT THIN. I'VE JUST GOT A SURE CALL ELECTRIC ALARM.

THIS ALARM IS JUST WHAT IS MOST NEEDED BY "THE MILLION," AND WE ARE PREPARED TO FURNISH THEM IN LARGE OR SMALL QUANTITIES. NO CHANCE TO OVERSLEEP. JUST AS YOU TURN OVER FOR 'ONE MORE SNOOZE" THE ALARM GOES OFF, AND RINGS AWAY MERRILY UNTIL YOU GET UP AND STOP IT.

AN AID TO THE ENERGETIC MAN, A NECESSITY TO THE LAZY ONE.

WRITE FOR CIRCULARS.

No. 610.

"O. & U." Wood Box Bell.

THE HANDSOMEST BELL OFFERED. MADE OF ANY KIND OF WOOD. AN ORNAMENT TO ANY ROOM.

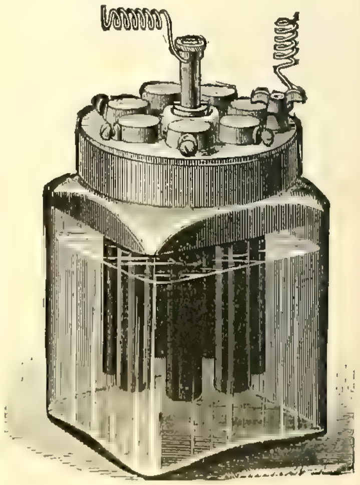
GAZE ON THIS PICTURE.

DIAMOND CARBON BATTERY.

THE GREAT,
THE ONLY,
THE UNIQUE.

TRY IT AND BE CONVINCED.

THEN ON THIS.



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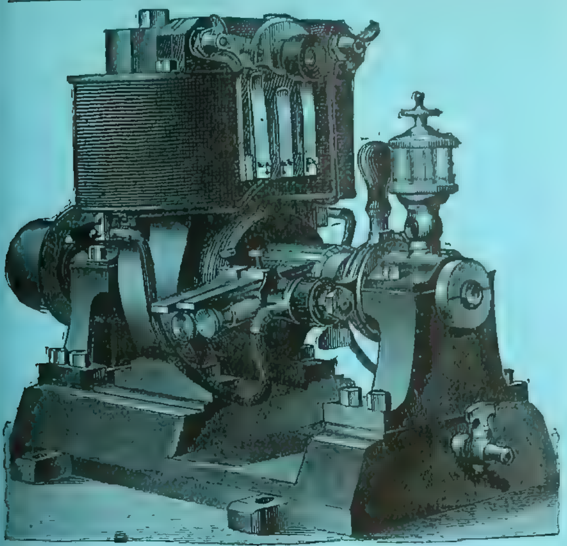

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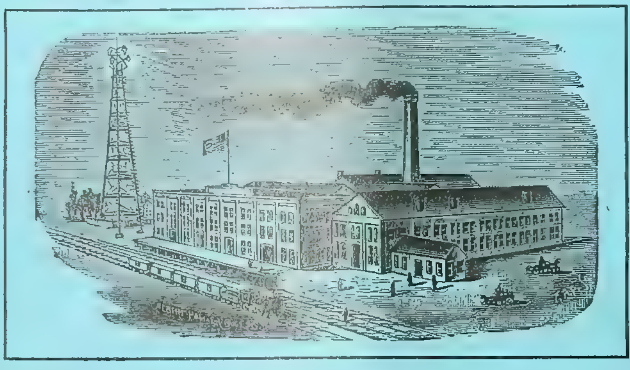

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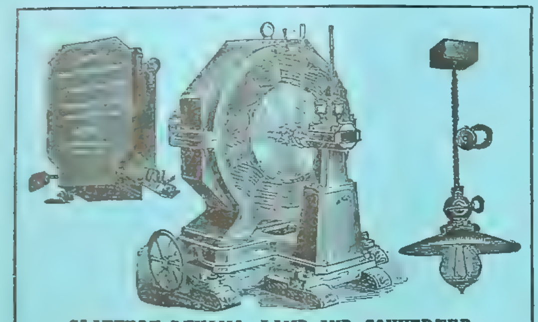

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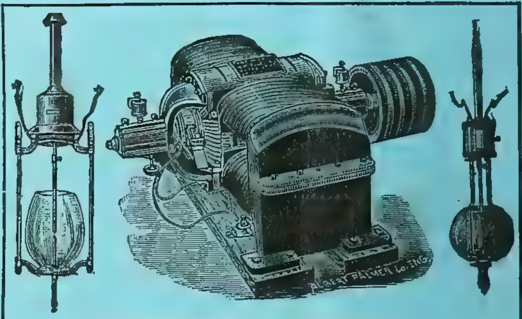

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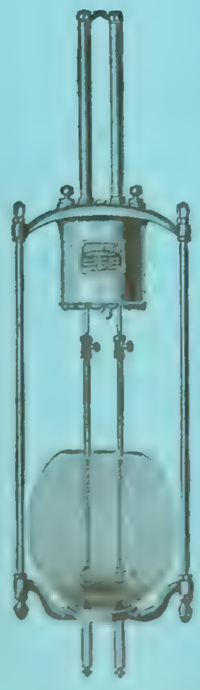

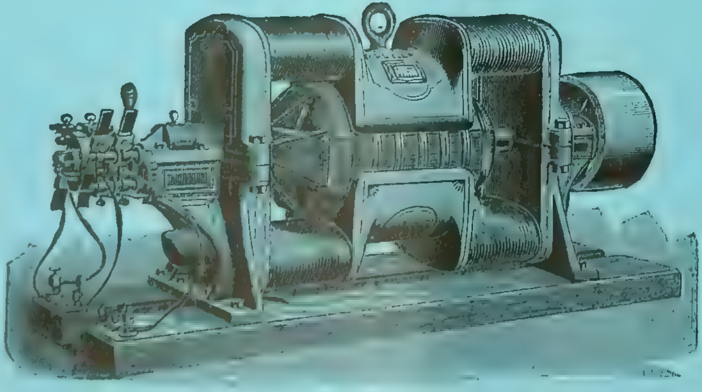

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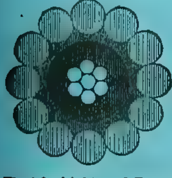

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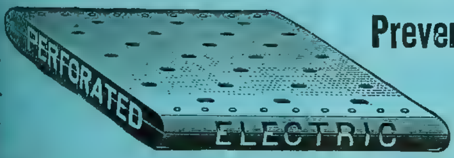

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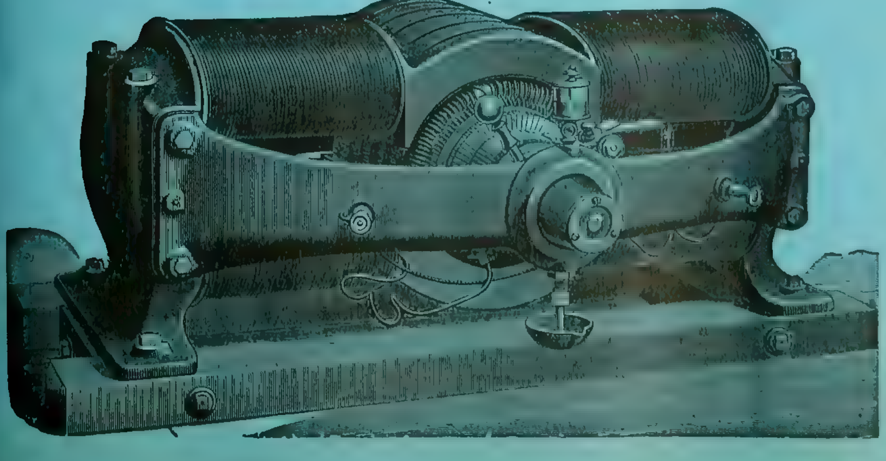

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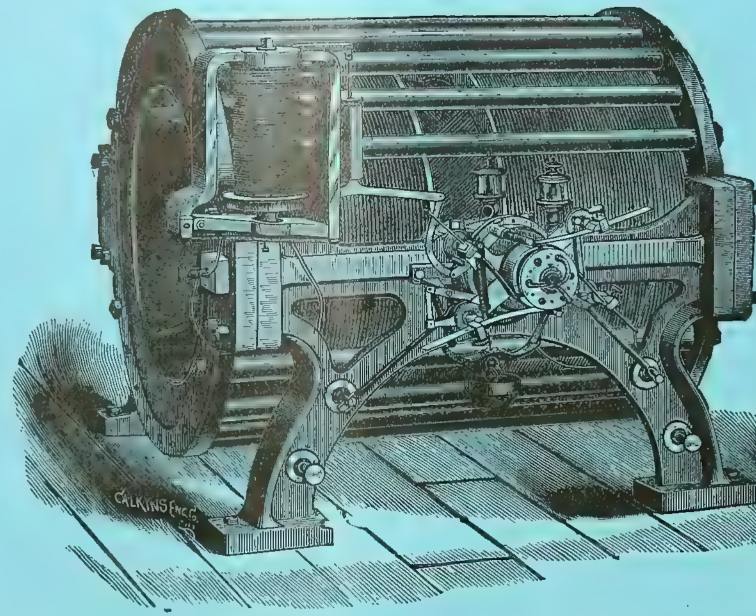

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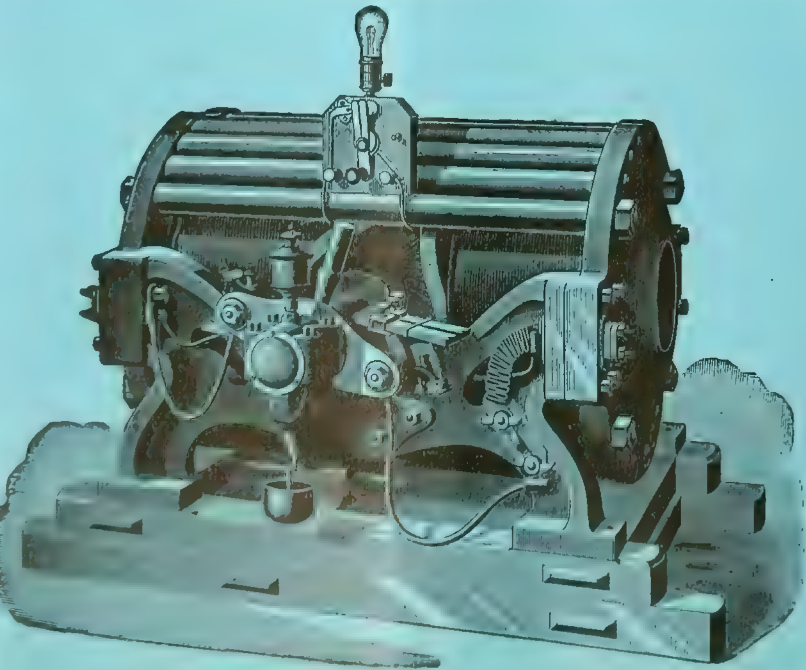

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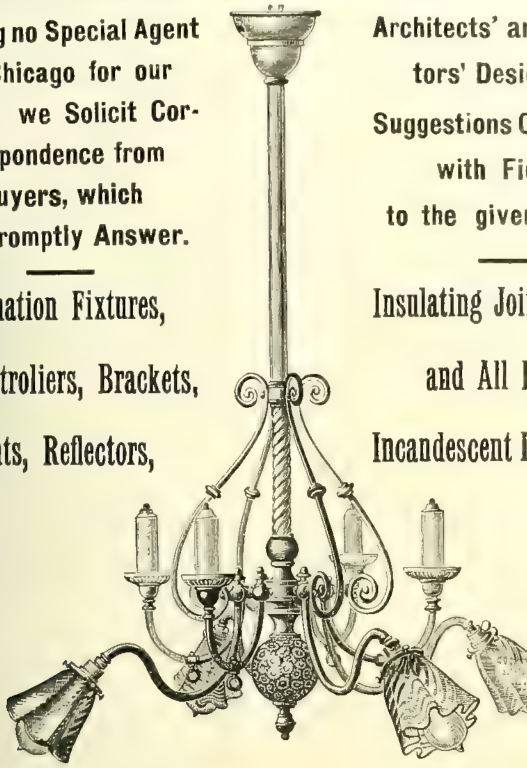

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GENTLEMEN—The wires we purchased of you last fall we used on our Barre Circuit, on which we run 38 arc lights, the nearest lamp being over four miles from our station. Some of the poles we are obliged to set on the very bank of the river. Last night the high water washed two of the poles out, and in falling carried the wire with them into the river, so that there was about 180 feet of both wires (being a return circuit) submerged all night, but we ran the 38 lights until shutting down time at 11 o'clock, four hours. Yours Respectfully,

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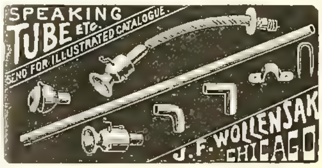

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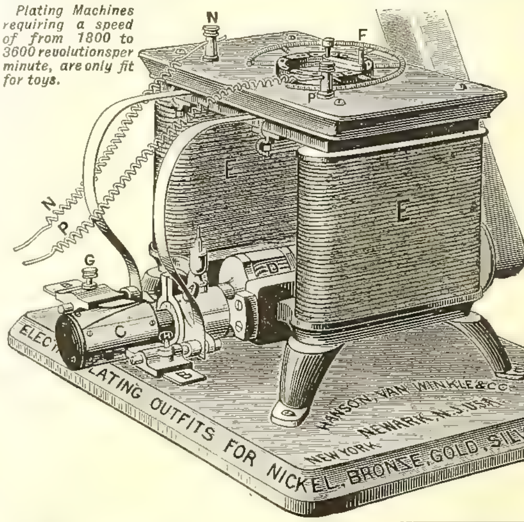

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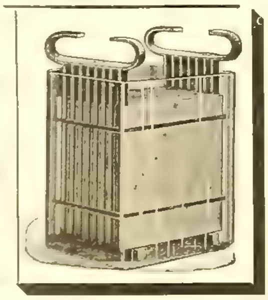

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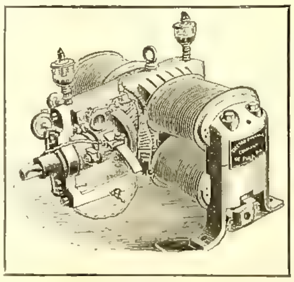

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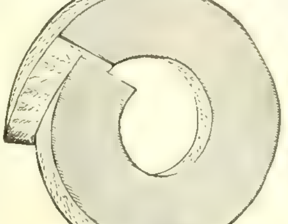

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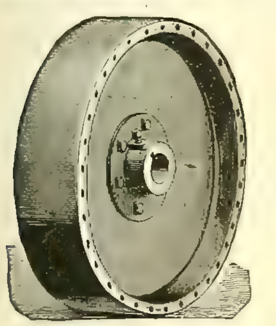

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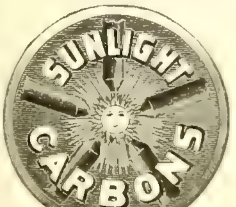

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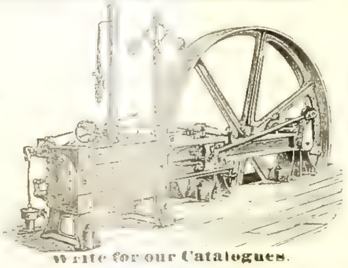

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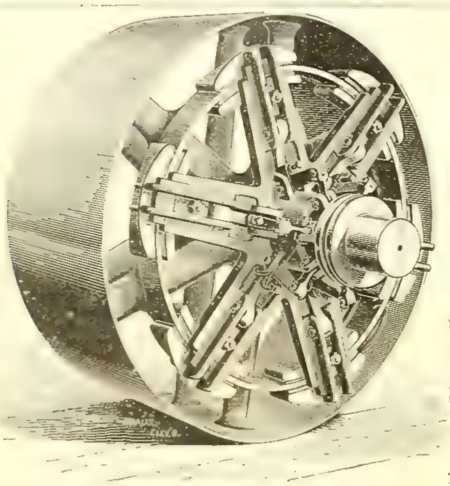

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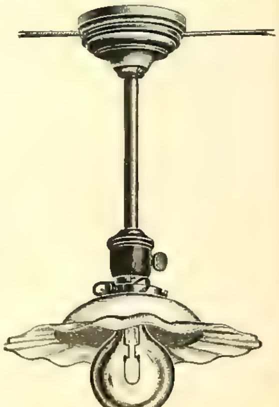

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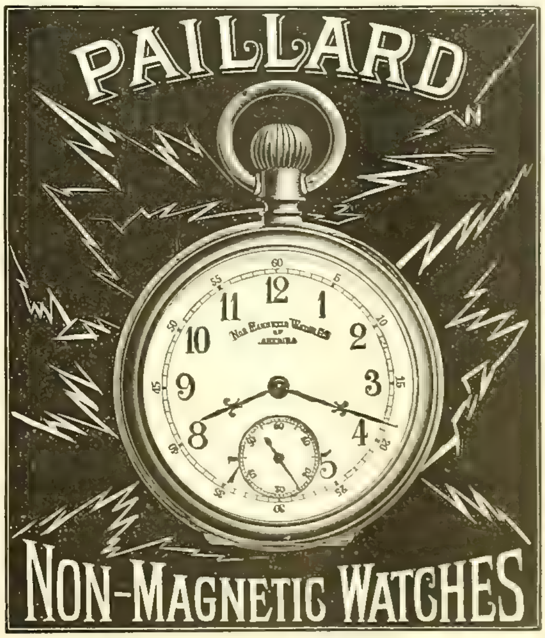

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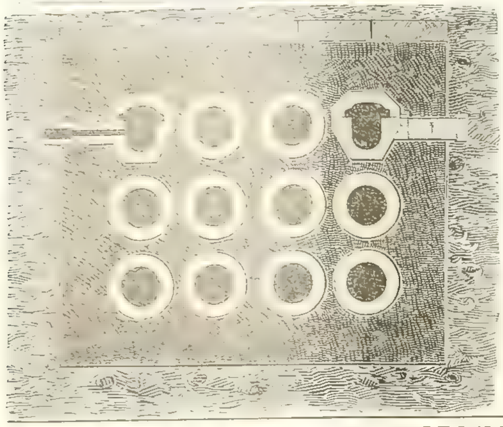

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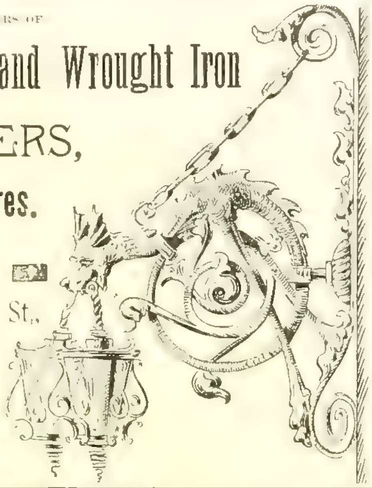

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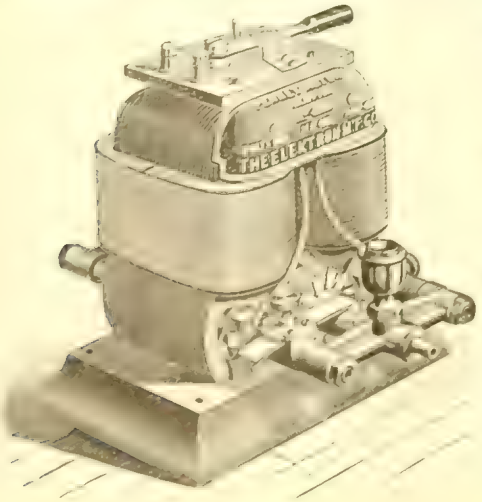

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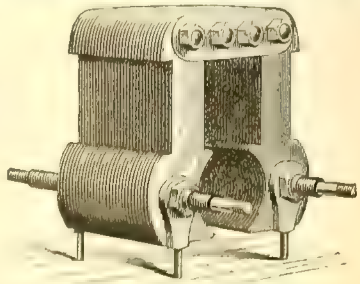

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In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor ?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

Thus the QUESTION OF LAW having now been settled by the Supreme Court of the United States, and the QUESTION OF FACT by the highest experts of the world, this company now notifies the Public of its intention to call a halt and demand a reckoning for the trespass and abuse of its rights in

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Vol. IV. CHICAGO, MAY 4, 1889. No. 18

Electric Lights in Tunnels.

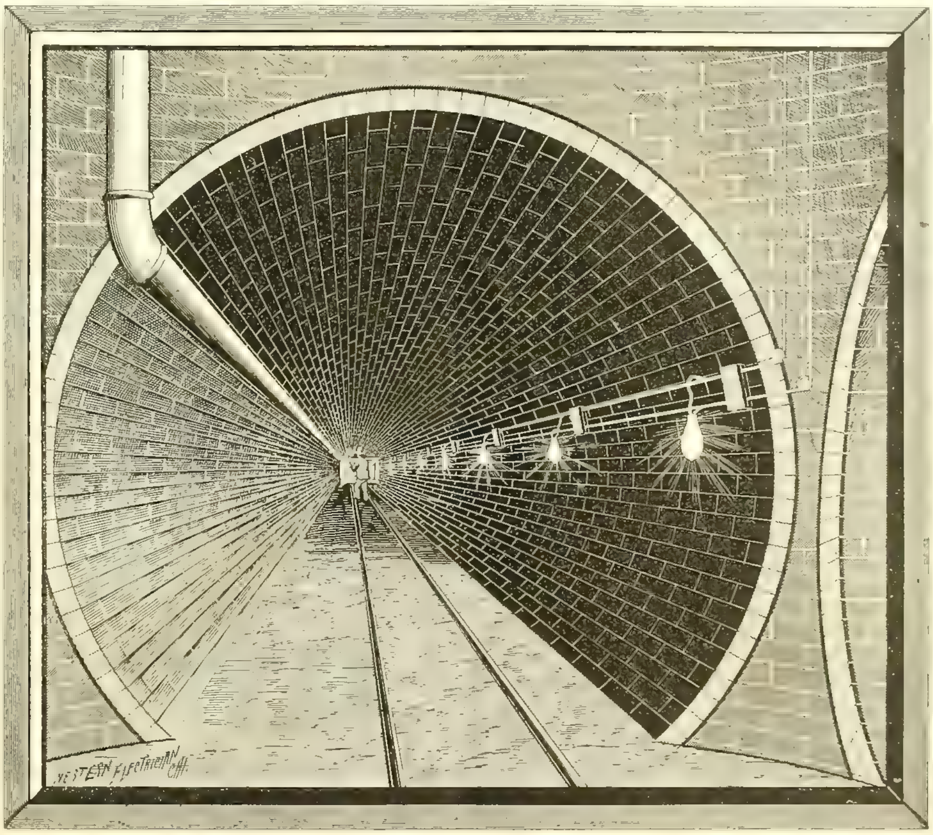
In the construction of tunnels and other underground work contractors have heretofore experienced considerable difficulty in securing light to enable their men to work. The miner's lamp, which was formerly used, did not fill the requirements. There were numerous objections to it, and when incandescent lighting was introduced, numerous experiments were made. The first successful work is said to have been accomplished in the building of Hyde Park tunnel four years ago. An electric light plant, consisting of a United States dynamo and 100 lamps, was used then. The new tunnel, now in course of construction at the foot of Park Row, Chicago, has an interesting installation. In July last A. Onderdonk, the contractor, became dissatisfied with the progress made by using oil lamps, and secured the plant now in use.

This plant consists of a United States dynamo, the same used in the building of the Hyde Park tunnel, and 75 lamps. Thus far 6,200 feet of wire has been utilized in the work. The dynamo is located in the engine room at the opening of the shaft, and is driven by a 12 horse power engine, which also runs a dummy used for hoisting trucks, transporting material and removing earth as it is dug away.

The shaft is 86 feet deep and 14 feet in diameter. Three tunnels open into it. That illustrated in the accompanying cut leads from the shaft to the water crib, and extends 1,700 feet under the lake. It is eight feet in diameter at the opening in the shaft, and extends out 300 feet. At this point two drifts, each six feet in diameter, lead from this tunnel to the crib. These tunnels, however, are not yet completed.

Two land tunnels lead from the shaft—one to Harrison and Desplaines streets and the other to Indiana avenue and Fourteenth street. At these points are the main pumping stations. Both land drifts are completed. Besides lighting the tunnels and the shaft, the lamps can be removed from one point to another by the workmen, thus giving them excellent light for their work. The additional cost of lighting a tunnel by electricity is more than compensated, it is claimed. The men can work better and accomplish more. The light furnished by incandescent lamps is far superior to that of any oil lamp in the market. By using electric lights the objections to miner's lamps are removed. There is no smoke or heat generated. A miner's lamp, moreover, consumes as much air as two men, and at times it became impossible to continue the work when they were used. In fact, the air often became so foul that the lamps would not burn. None of these difficulties are experienced in the work under consideration. The bright glow of the incandescent lamp is in striking contrast to the flicker of the dim oil lamp which was formerly used.

The arrangement of the lamps along the wall of the tunnel is shown in the cut which represents the main drift now in course of construction under the lake, viewed from the bottom of the shaft. The lamps afford an excellent light, and the tunnel at all times presents an interesting appearance. It is one of the most interesting installations in Chicago. The plant is in charge of John Andrews and Elmer Cook, and they are both very proud of it. Both say that while the excavations have been through clay and quicksand, and the wires have been roughly handled at times and covered with moisture, they have never experienced any trouble with the installation. The plant is kept running constantly as work is in progress both day and night.



ELECTRIC LIGHT IN TUNNELS.

Superintendent Onderdonk says that electric lighting is far superior to all other forms of illumination for tunnel work, and looks forward to the time when it will be universally used.

Chicago Electric Club.

The committees of the Chicago Electric club, which have in charge the work connected with the new club rooms, are hard at work. The finance committee reports that with the assessments and subscriptions it has a fund of $3,000 available for rearranging and furnishing the new rooms. The committee on furnishing is securing estimates on furniture and carpets. A force of men is engaged in the rooms in the High building, removing the partitions. The furnishing committee will be re[illegible] actively in its work as soon as this work is [illegible]pleted. Leonard & Izard have a force of men at work wiring the rooms for incande[illegible] lights. The work is progressing [illegible] the committees are enthusiastic over the [illegible]pect.

Electricity in China.

Two distinguished looking Chinamen, in the picturesque costume of their country, cut quite a figure at the Palmer house, Chicago, last week. They were accompanied by an attendant whom they had imported from the Orient. The only apparent duty of this attendant was to receive attention from curiosity seekers whom his masters did not wish to see, while the visitors labored under the impression that they were being entertained by a Chinese nobleman.

Ku, Koo and Glu were the names of the trio. Ku is secretary of the board of punishments of China and his imperial Chinese majesty's commissioner to America. Mr. Koo is S. I. Euland Koo, of the Chinese legation at Washington, and the third member of the trio is plain Mr. Glu, servant of the commissioner. Mr. Koo was the only member of the party who could speak English, and, as he acknowledged, he is not proficient in the language. He explained to a representative of the WESTERN ELECTRICIAN that the object of Mr. Ku's visit to this country was to obtain information about the system of electrical execution recently adopted in New York and now under consideration in many other states. In China, Mr. Ku explained through the agency of Mr. Koo, who acted as interpreter, they still adhere to old methods, decapitation being the penalty for murder and hanging for theft. Both agreed that hanging was a step in advance of decapitation, while Mr. Koo expressed the belief that electricity was preferable to either of the other methods. Commissioner Ku will recommend, on his return to China, the substitution of electricity for the present methods of execution. He has visited Brazil and other countries, and will remain in Japan about 100 days before returning to China. Mr. Ku has not confined himself to a consideration of the systems of executions in vogue in the countries in which he has traveled, but has noted carefully the principal features of industrial advancement. [illegible] Messrs. Ku and Koo are deeply interested in electrical development, and naturally visited Chicago to secure information on this subject. According to their statements, China is ahead of Japan in these matter.

"Three years ago, when I left China," said Mr. Koo, "electricity had been used for some [illegible]

[illegible] ing incandes-[illegible], residences and [illegible] extensively used in [illegible] Kong, Shanghai, Canton and other cities have a great many elec-[illegible] these papers that electric lighting is becoming general in all the large cities, and is also gaining a foothold in the [illegible]. Mr. Ku confirms these state-

FIG. 1. NEW ACOUSTIC TELEPHONE.

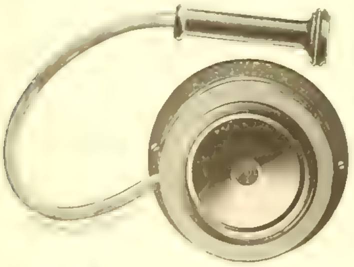
ments. I have no doubt that electric railroads will soon be introduced into China, now that they have both railroads and electricity."

Mr. Ku returned to San Francisco Thursday evening, accompanied by Mr. Glu, but Mr. Koo remained in Chicago until Sunday evening, when he returned to Washington to resume his official duties. Mr. Ku will embark for Japan immediately, and then return to China and make his report.

New Acoustic Telephone.

The accompanying cuts represent the "Little Gem" telephone, manufactured by H. A. Leach & Co. of Sparta, Wis. This device is a new acoustic telephone just introduced, and is admirably adapted, it is said, to factory use and private lines. It can be operated five miles, and is not affected by the weather, it is claimed. It is both neat and durable, and is highly efficient. It is also an economical device, and can be kept in repair without any trouble or expense.

In the accompanying cuts are represented several styles of this telephone. Fig. 1 represents a transmitter, receiver and magneto bell, while Fig. 2 shows the transmitter and receiver



[illegible]

[illegible] ll and push but-[illegible] and [illegible] on receiver and [illegible]

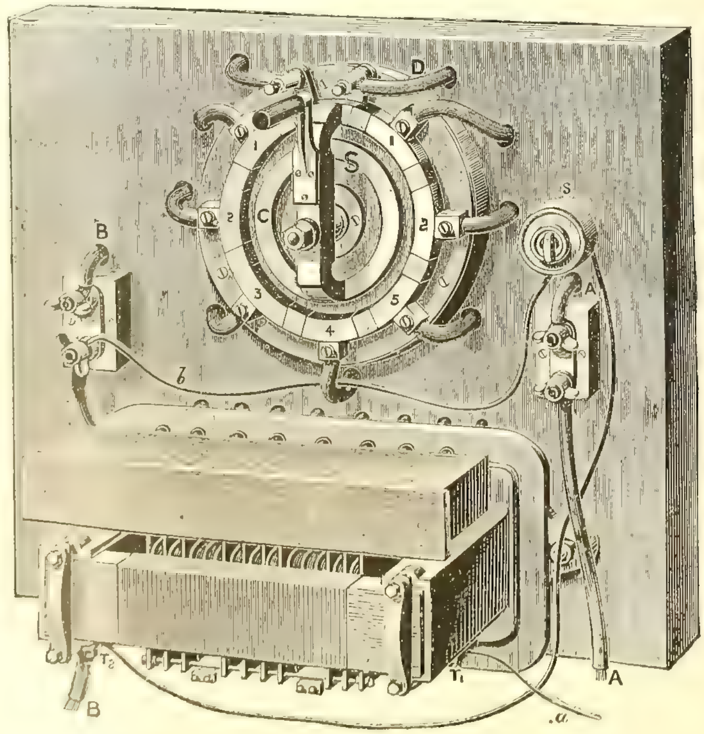
[illegible]

The Kapp Regulating Transformer.

Among the [illegible] advantages possessed by the system of alternating current distribution, is that of [illegible], says *Industries* of London. One of the most important conditions in any system [illegible] station lighting, is that of keeping the pressure at the points of consumption as nearly as possible constant. In the direct current system, equality of pressure over the area supplied from a central station by feeders is generally obtained by the insertion of rheostats into these feeders; but this plan, besides entailing a considerable amount of watchfulness and labor on the part of the attendant, has the disadvantage of wasting energy. With an alternating current supply on the feeder system, the problem can be solved in a far more simple and less wasteful manner. Constant pressure at the feeding points, at all times and for all loads, can in this case be obtained by the insertion of a small transformer into each feeder, which raises the pressure at the station end of the feeder by the exact amount which is lost on the way in consequence of the ohmic resistance of the feeder. The primary coil of the regulating transformer is connected with the terminals of the dynamo, and the secondary coil is subdivided into a number of sections connected with a multiple contact switch. The current flowing to the feeder is led by means of this switch through one, two, or more of the sections

FIG. 3. NEW ACOUSTIC TELEPHONE.

of the secondary coil, and receives there an additional e.m.f. proportional to the number of sections inserted. The regulating transformer is so proportioned that, when the whole of its secondary coil is inserted, the increase of pressure is just sufficient to make up for the loss due to the ohmic resistance of the feeder. If the current flowing out is below the maximum, the



KAPP REGULATING TRANSFORMER.

[illegible] intermediate point, so that [illegible] the distant feeding [illegible] This principle of regulation [illegible] by Gisbert Kapp, [illegible] application in central [illegible] for regulating the [illegible] in private installa-

tions; and we illustrate herewith one of these regulating transformers, as fitted to the electric light installation at the town house of Sir David Salomons, Bart., which is supplied with current from the Grosvenor Gallery. The whole apparatus is placed on a board, and fixed against the wall, the transformer occupying the lower part, and the multiple contact switch the upper part of the board. In this particular case it was desired to have means for either raising or lowering the pressure in the lamp circuit, and the secondary coil of the transformer has therefore been

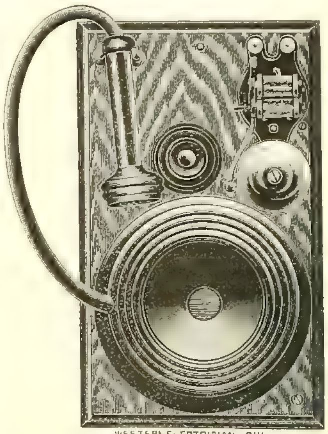


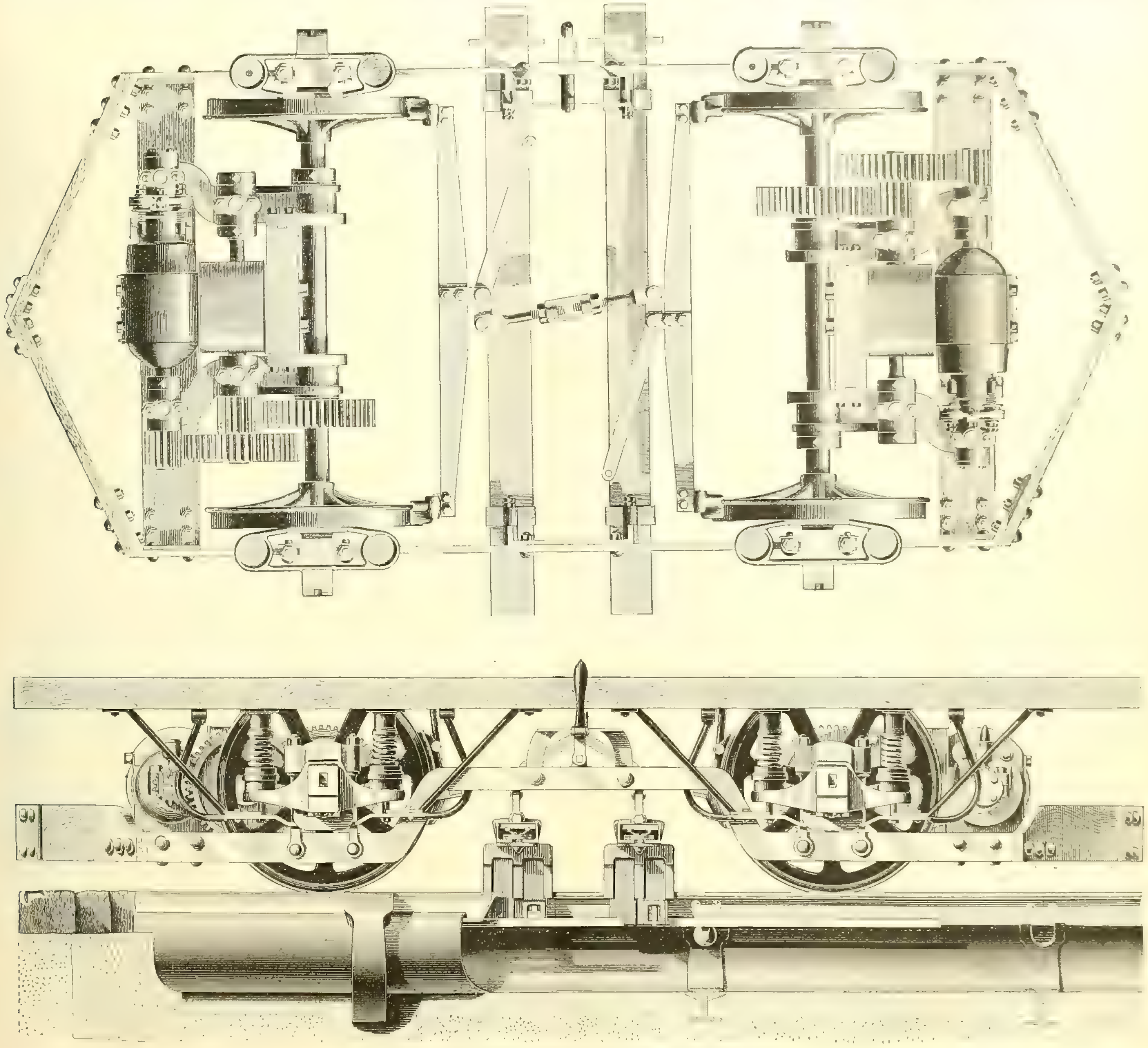
FIG. 2. NEW ACOUSTIC TELEPHONE.

divided into seven sections, five of which are traversed by the lighting current in one direction, and are used for raising the pressure, while the remaining two are traversed in the opposite direction, and are used for lowering the pressure. The switch has accordingly seven contacts. When the handle is in the position shown in the diagram, the whole of the secondary coil is cut out, and the pressure supplied to the lamps is that given by the secondary coil of the main transformer, which serves this installation. If the switch handle be moved to the right over the contact marked 1, the current in the lamp circuit is caused to flow through one of the opposing sections of the secondary coil, and the available pressure at the lamps is reduced by 2 volts. If the switch handle be further moved to the right over contact 2, the second section is brought into circuit, and the e.m.f. is reduced by 4 volts. On the other hand, if the switch handle be moved to the left, those sections of the secondary coil in which the e.m.f. is additive are successively brought into circuit, each step adding 2 volts to the available pressure at the

lamps, so that by moving the switch handle round to the contact marked 5, an increase of 10 volts over the pressure given by the main transformer is obtained. The connections are as follows: The service leads from the main transformer are brought to two terminals, to which the main lamp circuit is connected. Into one branch is inserted the regulating transformer, connection being made with the cables A and P. One terminal T_1 of the primary coil of the regulating transformer is connected with one of the main terminals of the supply current, and the other terminal T_2 is connected by means of the switch *s* and wire *b* with the cable P coming from the other main terminal. The switch *s* is inserted so that the primary can be cut off if the instrument is not required. The cable P is connected by a fuse and lead B with the inner contact C of the multiple contact switch S, and the cable A is similarly connected with the middle or zero contact of the switch by the lead D. The other contacts of the switch are connected with the different sections of the secondary coil in the manner already explained. The advantage of this regulating apparatus is that without appreciable loss of energy, and by merely setting the switch to one or other of the contacts, the brilliancy of the lamps throughout the whole house can be regulated, while the regulating power is the same whether only a few lamps or the whole of the lamps in the house are alight. A rheostat or a choking coil could be used to lower (though not raise) the available pressure, but the effect would in either case be influenced by the number of lamps in use at a time. With the apparatus above described, the increase or diminution of pressure is, however, quite independent of the number of lamps in use, and the consumer is able to burn his lamps with either a higher or lower voltage than that supplied from the central station.

Bentley-Knight Double Motor Truck.

The accompanying cuts exhibit the construction of the Bentley-Knight company's standard double motor truck. Each motor is 15 horse power. These trucks are the heaviest yet built and operated for electric tramway service, and are an improvement upon those which have for the past year and a half been in operation on the Observatory Hill Passenger railway at Allegheny City, Pa., equipped by the Bentley-Knight company. Trucks, such as are shown, are now running on the West End Street Railway company's line in Boston, where they pull two cars every day and three cars on Sunday. They are adapted equally well for use with either elevated conductors or with the conduit system. In the cuts they are shown equipped for use with the conduit, of which latter a side view, showing construction and all necessary attachments, is given.



BENTLEY-KNIGHT DOUBLE MOTOR TRUCK—PLAN AND SIDE VIEW.

The motors herewith shown are fitted with every appliance to insure simplicity of parts and economy and durability in commercial use ... struction is the manner in which the motors themselves, together with all their gearing, is supported outside the space between the axles of the car, thereby giving the greatest ease in reaching all wearing parts, whenever necessary. The motors are thus carried in the position where they are least in the way and least exposed to the splash of mud and water from the wheels.

The spring support given each motor makes the wear on working parts and on the tracks extremely light, while allowing the motors to have a yielding impact on the load at starting.

Cut gear is used throughout; all journals are held in rigid castings and the gearing is practically noiseless at all times. The commutator brushes are fixed in position when the motor is first tested, and thereafter need no adjustment either for change of load or direction of motion.

While the Bentley-Knight company has care-

[illegible] investigated the question of conduit con- [illegible] its successfully, [illegible] cution to such [illegible] Bentley-Knight company has to-day in operation an elevated [illegible] the test of two winters with success, the road at Allegheny City, [illegible] neral difficulties

FIG. 1. PERKINS INCANDESCENT LAMP.

of that road are, the company claims, greater than those of any road which has so far employed electricity. In Boston the Bentley-Knight motors, while running over three miles of conduit, are also employed over twelve miles of elevated conductors. The Bentley-Knight company neither advises nor desires the construc-

[illegible]

to meet the steep pitches and constant curves of this line. Each of the cars to be sent to this line is guaranteed to tow another car after it, at fifteen miles per hour. This line in all comprises twelve miles of elevated conductor, which will be partly suspended across the roadway from poles at the curb, and partly operated from elevated conductors bracketed off from poles set at the side of the street.

Perkins Incandescent Lamp.

W. G. Halm, vice-president of the Perkins Electric Lamp company, has established the headquarters of the western agency of the company at 54-56 Franklin street, Chicago, and has assumed personal supervision of this department. The Perkins incandescent lamps, which are manufactured by this company, have a wide reputation for their efficiency and durability. Little attention has heretofore been given to the western trade, but special efforts will now be made to develop this territory. It is claimed for the new Perkins lamp, which is herewith illustrated, that it possesses not only high efficiency and durability, but also is free from discoloration. Under similar conditions, it is asserted, it will yield as much light the thousandth hour as the first, thus making it desirable for factory work. In the accompanying cuts the special features of the new Perkins lamp are illustrated. Fig. 2 shows the 16-candle power lamp, while Fig. 5 represents the 32-candle power lamp. The interior of the lamp and socket switch combined is illustrated in Fig. 1, and the standard socket switch in Fig. 3. A

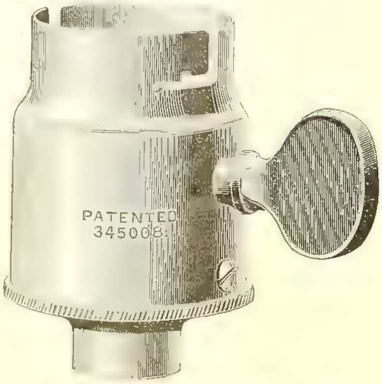


FIG. 3. PERKINS INCANDESCENT LAMP.

device for burning the lamp with one or two filaments is shown in Fig. 4. The company has received numerous testimonials from persons who have used their lamps, in which they state that they have exceeded the promises made for them.

New York Board of Electrical Control.

At the meeting of the New York Board of Electrical Control on the 24th ult., the Centennial celebration committee applied for permits for temporary wires along Broadway and Fifth avenue for the purpose of furnishing lights during the time of the celebration. The application was favored by Commissioners Hess and Gibbens, but the mayor emphatically opposed it. In the first place, he objected to granting privileges to corporations which had deliberately and designedly broken faith with the board, and he therefore wanted much better reasons for granting permits than any that had been stated. He said this with the fullest wish to do everything reasonable in the way of giving the city sufficient light during the centennial. It transpired that several [illegible] had been strung since April 15th, and [illegible] determination to find out forthwith which the delinquent companies were. He [illegible] to secure the desired in[illegible] the companies which had [illegible] meeting, but did not suc[illegible] had been granted for [illegible] First avenue, where [illegible] without permits, and the [illegible] whether the suspected [illegible] ler the permits or not. [illegible] action by a report [illegible] which showed [illegible] attempted to hoodwink [illegible] of the board by

various subterfuges. On one occasion some line work at Third avenue and Eighty-sixth street was stopped, and the production of the permit demanded. The officer was told that the super-

FIG. 4. PERKINS INCANDESCENT LAMP.

intendent at the other end of the line had it. When the other end of the line was reached the officer was told that the foreman had gone home

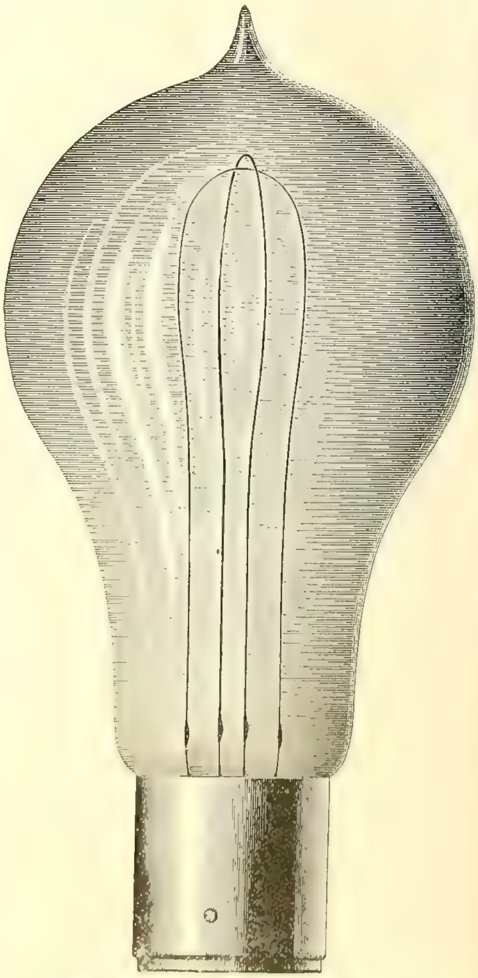


FIG. 5. PERKINS INCANDESCENT LAMP.

sick, and had taken the permit with him. It was finally produced, but it proved to be a lapsed permit of a year ago. The workmen said it had been renewed, but this was false. Commissioner Gibbens suggested that a committee, consisting

of the mayor, a member of the commission, and the superintendent of lamps and gas should be appointed to consider the matter of lighting the districts which are now insufficiently illuminated. This, however, the mayor declined to do, and he said that he would take no step that would lead directly or indirectly to the grant of privileges to any company which had attempted to thwart the board. President Moore of the Brush company asked to be heard, but the mayor declined to listen to him, saying that of all the companies that had acted in defiance of the law, the Brush company most deserved punishment, and a punishment that should certainly be meted out to it, for having allowed a deadly current to remain on its wires while the operation of taking them off the poles was in progress.

Commissioner Gibbens tried to modify the mayor's views, and said he saw no reason why the punishment of the sins of the Brush and other companies should fall on the Centennial committee, and he thought temporary measures might be adopted that, without prejudice to the present or prospective position of the board, would give the city light during the Centennial. The expert, Dr. Wheeler, was instructed to find out what companies had strung wires without permits, and report to the board the following day, and the mayor stated that he should favor the granting of the exclusive right to make arrangements for temporary lighting to the company that had not violated the rules of the board.

The board sat again on the following day. The expert's report was read. It showed that the wires in First avenue, supposed to belong to the Brush company, were owned by the Manhattan Electric Light company, and that the accusation that the Brush company had run wires on Twenty-fifth street since April 15th was not substantiated.

The mayor said: "Mr. Wheeler informs me that in some of these cases he has had people arrested who were stringing wires without a permit, and when arraigned before a police magistrate they were discharged with a reprimand. I wish now to give public notice that should any such case occur again, I desire to have the information brought to me, and I will bring the matter to the attention of the grand jury, and ask to have the accused persons and companies indicted. I don't regard it as a wise thing to have the expert and the engineer of this board going before a police magistrate with such cases, and then to allow the delinquent companies to go on stringing wires."

Dr. Wheeler continued his report which stated that the East River company had been placing lamps on circuits in contravention of the law.

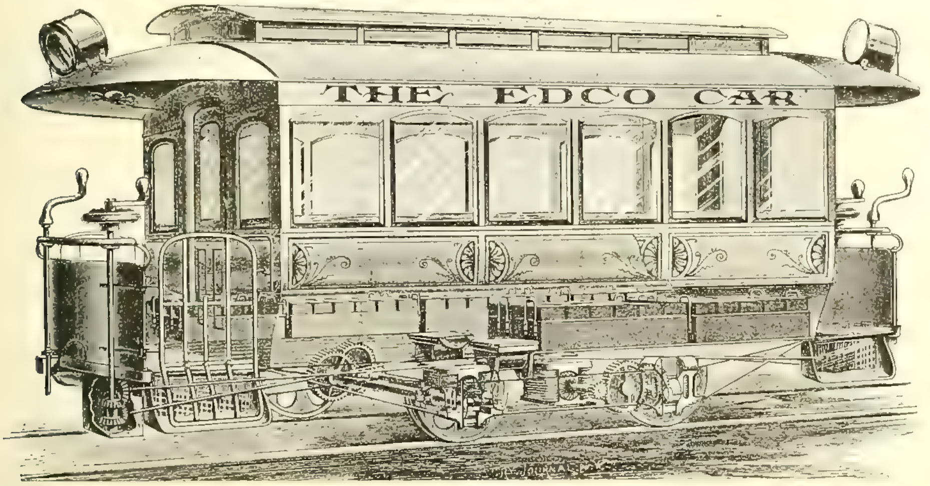
Mayor Grant said: "Is there any company against which there is no record in your office as having strung wires in bad faith and contrary to the rule of this board? That is what I want to know. I believe from my investigations that there is only one company that has not violated the rules, and that one is out of existence, or rather is under new management. I mean the United States company. If this is so, this company ought to be rewarded with a permit of some sort."

The mayor then asked Mr. Stroller of the United States company if his company could light Madison Square. Mr. Stroller said it could, and could be ready to light the lamps by Saturday night.

Commissioner Gibbens moved that Mr. Stewart be given permission to light the arch at Fifth avenue and Washington Square for ten days. The mayor said he should vote for the resolution, for the Edison company's representative had frankly acknowledged that a wire had been stretched to the arch without permission, but had been since removed.

Commissioner Gibbens asked the mayor if he would vote for a resolution giving Mr. McCormick authority to issue permits to electric light companies to put up temporary wires during the Centennial celebration. The mayor said he would give such a permit to the United States company, but no other. It was eventually decided to appoint a committee, consisting of the mayor, Commissioner Gibbens and Superintendent McCormick, which should have authority to grant to the United States company power to string temporary wires for the lighting of Madison Square and other places.

A petition of the Metropolitan Telephone & Telegraph company for permission to string house-top wires from the Western Union building at Broadway and Twenty-third street, to supply customers in the Fifth Avenue hotel, the Hoffman house and other buildings, provoked long and earnest discussion, and eventually it was decided that it should be laid over.



EDCO STORAGE BATTERY CAR.

Edco Storage Battery Car.

The experimental storage battery car "Edco," which has been running successfully in Philadelphia, is illustrated in the accompanying cut. The illustration is taken from the May number of the *Street Railway Journal*, from which paper the following description is also taken: The car, which was built for the Electro-Dynamic company of Philadelphia, is equipped with accumulators supplied by the Electrical Accumulator company of New York.

The engraving is made in such a manner as to render transparent those parts of the car which would otherwise hide from view the motors, gearing or batteries, and all the working parts, with the arrangement of the batteries, are thus clearly in sight. The car is slightly heavier than the ordinary street car, and its two electric motors with its necessary gearing weigh about a ton. The batteries, which weigh about one and a half tons, consist of eighty-eight hard rubber cells, hermetically sealed, and are located under the seats of the car. The motors are made to give 3,000 revolutions a minute with the full force of the batteries, but by the use of gear wheels this is reduced so as to run the car at the ordinary speed of eight or ten miles an hour. The commutator box is so arranged that the cells may be put in series or into parallel, according to the character of the work to be done. The driver controls the application of the power by means of a suitable wheel.

Each of the motors will give 13-horse power when the full force of the batteries is applied, and this is ample for any work which they may [illegible] times, together with several shorter trips, with [illegible] charge them.

The Electrical Accumulator company has two methods of applying the power [illegible] for street car work: The one where the batteries are carried on the car itself, and the other where they are placed on a separate car, about nine feet long, seating about ten persons and suitable for a smoking or second class car, the smaller car being coupled to the passenger car.

Extending Chicago's Electric Light Plant.

The operation of the city plant in Chicago has proved eminently successful, and there is a universal demand for the immediate extension of the system in all directions. Taxpayers in every portion of the city are clamoring for electric lights on their streets, and all want them immediately. This is certainly an indication of confidence in the new departure, and is flattering to Prof. Barrett, the city electrician, but it imposes upon him the necessity of explaining to each of these applicants for favor that, while there is no question as to the justice of his claim, it may be necessary to give way to others of more pressing importance. Considerable work will be done, however, in this department during the approaching season. As soon as Mayor Cregier can dispose of the army of office seekers who hound him constantly, he will devote his attention to the problem prepared for him by City Electrician Barrett. It will prove an interesting subject. There are between $300,000 and $400,000 to be expended next summer, and the amount will depend largely on the length of the season. Work will be continued as long as possible.

Prof. Barrett has been examining a number of desirable sites for power houses, but thus far none have been secured. The present station will be enlarged, and additional stations will be required on the north and south sides. It is expected that the south side will be lighted by electricity as far as Twelfth street, and that double the present number of lamps will be erected on the west and north sides. The work this year will not cost proportionately as much as it did last year, for the conduits then constructed were designed for future utilization, and many of them will now come into use.

New Cincinnati Central Station.

George F. Card of Cincinnati was in Chicago last week for several days, inspecting central stations. The Cincinnati Gas company proposes to erect a large electric light station, and Mr. Card is traveling on a roving commission in search of information which will make the new station a model plant. He has visited Columbus, Pittsburgh, Cleveland, Detroit, Fort Wayne and Indianapolis. The new plant will have a capacity of from 2,000 to 3,000 horse power. About 1,000-horse power will be utilized at first, and particular attention will be paid to arc lighting at the outset. Eventually the company will employ a large number of incandescent dynamos, and will distribute power on a large scale. Neither dynamos nor engines have been decided upon, and work on the new plant will not be begun for several months yet. Overhead circuits will be employed, though it is proposed to make a number of experiments with underground cables. There are already four central stations in Cincinnati, and lively competition is anticipated when the new plant is completed.

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W. A. KREIDLER, [illegible] Editor and Publisher

J. W. DICKERSON, - [illegible] Associate Editors

J. B. O'HARA, [illegible]

A. C. PEREBOROW, JR., [illegible] Business Manager

EASTERN OFFICE, [illegible] TEMPLE COURT, NEW YORK.

W. H. [illegible] Manager.

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THE San Francisco letter published this week indicates that business in the electrical field is unusually active just at the present time.

AN exchange says that electric motors have done much to make the labors of the Society for the Prevention of Cruelty to Animals less arduous, although it hastens to assure the representatives of the organizations that their work is not yet done.

[illegible]

[illegible]

[illegible] lamps [illegible]

THE work of taking down poles in New York city was [illegible], and the progress made is noted in the New York letter. Mayor Grant is by no means well disposed toward the electric companies. The report of the meeting of the New York Board of Electrical Control shows that he is determined to maintain strictly the position which he assumed. He will not consider any form of compromise. His interference with the wires was commenced at a rather unfortunate time, just before the Centennial celebration.

THE Michigan house of representatives has taken a step toward the restoration of the death penalty in the state. A bill has been passed providing for the infliction of capital sentences by hanging or electricity. Before the death penalty can be inflicted each juryman must sign a verdict recommending it, and the presiding judge may, in his discretion, sentence the prisoner to death or life imprisonment. A clause in the bill provides that no newspaper reporters shall witness executions. This provision will probably stir up trouble in Michigan, as it has done in New York state.

WHEN representatives of eastern nations are in search of electrical knowledge, they start straightway for America. A number of illustrations have been mentioned in the last year, and in the present issue another case in point is given. A Chinese dignitary is traveling through the land in search of information relative to electric executions. A brief interview with the Chinese representative appears in another place. The Chinese have two death penalties at present—hanging for thieves and beheading by the sword for murderers. A uniform penalty is wanted, and the commissioner proposes to investigate the claims of the electrical method. Whether he will be on hand at the time of the first execution under the new law in New York remains to be seen.

IN another column is outlined a comprehensive plan for rapid transit in Chicago. The system of elevated roads which is described would involve an expenditure of about $18,000,000. Chicago has been considering elevated railroad schemes for a year or more, but all the plans have come to naught up to the present time. There is unquestionably a demand for better facilities for transportation than such as are afforded by existing lines. The west and north sides have wretched street car facilities. The south side can boast of far better transit. It seems to be generally conceded that in the near future elevated roads will be built, but whether the structure will be as lofty as that advocated in the article presented in another column is another question. It has been frequently urged against the elevated road system that its unsightly structure mars the appearance of every street through which it runs. An elevated road built over the roofs of houses, as suggested by Mr. Stoltenberg in his article, might not make any one street unsightly, but it is a question whether it would not mar the general appearance of a city. Nothing is said about motive power for the proposed elevated road, but no one, in view of the recent advances in propulsion by electric motors, can question that the motive power will be electricity.

THE telephone bills have been the cause of much bitterness in the Illinois legislature during the last few days. At the meeting of the committee on municipal corporations April 24th the [illegible] bill, which gives common coun[illegible] to regulate telephone rates, [illegible] voted to recommend [illegible] One of the members of the com[illegible] session: "The reason [illegible] is that I don't be[illegible] have any business [illegible] common council [illegible] shall not pay [illegible] to [illegible] You [illegible] to empower city [illegible] of bread or what [illegible] exception. If you [illegible] telephone company, why not extend that principle to everything else?" On the following day it was moved to reconsider this action. Mr. Chott made the motion, stating that after making a careful examination, he had come to the conclusion that it would be exceedingly unwise to vest the regulation of telephone rates in any such body as the Chicago common council. The motion to reconsider, after an acrimonious dispute, prevailed.

The Eckhardt-Baker bill, which regulates telephone rates throughout Illinois, met the same fate April 24th that it sustained the previous week. A motion to suspend the rules and take up the bill failed by a vote of 63 to 59. Senator Eckhardt is quoted as saying: "I am sorry that the house has not seen fit to pass the telephone bill, and I doubt if it will this session, as the votes this afternoon appear to be almost decisive."

THE effect of Mayor Grant's summary treatment of refractory electric companies in New York city is noticeable in Philadelphia. A dispatch dated April 24th, from the latter city, states that it is proposed to follow New York's example. The message is as follows: "The subject of removing the poles and wires from the streets of the city came up for consideration to-day before a sub-committee of the committee of councils on law, to which had been referred the resolution offered in select council, 'desiring the commissioner of public safety to notify the several telegraph, telephone and electric light companies to remove all the poles and wires from the streets in the built-up portion of the city by the 1st day of October, 1889.' Representatives of the various companies were present, and contended that it would be impossible to place the great number of wires underground in the limited time allowed by the ordinance. It was further claimed that underground systems had generally been found impracticable. No action was reached by the committee, which adjourned subject to the call of the chairman." Unquestionably such an ordinance as the one outlined in the dispatch would be in the highest degree unjust. Six months is decidedly too short a time in which to bury the wires of a city the size of Philadelphia. There will be, undoubtedly, in the next few months a number of cases in which companies will be called upon to commence underground work at short notice, as a result of the New York incident.

THE fact that the American Bell Telephone company was seeking to increase its capital stock has been referred to. The company's object is to secure funds for the extension of its long distance telephone system. The Boston *Herald*, in an article on the subject, says: "When the time comes that a merchant in Boston can call up and converse in a minute's time with a business man in New Orleans, St. Paul or San Francisco, that is, when he can obtain telephonic connection and converse as readily over these distances as he now can by telephone between his office and that of a fellow-merchant whose office is a few blocks off, then a trade gain will have been secured, the value of which, both social, political and industrial, it would be difficult to over-estimate. For some time to come the expense of carrying on conversation over these long distance telephone lines must be so great as to limit their use to a comparatively few persons, whose business transactions have an importance and magnitude which warrants them in going to a considerable expense in putting themselves into immediate communication." After speaking of improvements in telephony and of the expiration of the patents, it continues: "If it can, in the meantime, construct a great system of long-distance telephone lines, connecting together all of the cities outside of the Rocky mountains, it seems to us that the public is destined to gain great advantage from this construction, if not immediately, at least when, by the lapse of patents, the company is forced to materially lower its tolls in order to hold its field against active competitors. We trust, therefore, that no opposition will be thrown in the way of the proposed increase of capital stock, and that the company may enter without delay upon its proposed work."

Rapid Transit for Chicago.

Elevated roads for Chicago have been a fruitful topic of discussion in the last year. To almost all the plans which have been proposed for the solution of the rapid transit problem, innumerable objections have been made. In the

FIG. 1. RAPID TRANSIT FOR CHICAGO.

April number of the *Street Railway Gazette* appeared an article by H. A. Stoltenberg on this subject. An abstract of this article is given herewith, together with the cuts which also appeared in the same journal. After speaking of the probable growth of Chicago and the necessity for rapid transit to accommodate a rapidly increasing population, Mr. Stoltenberg takes up the objections which would follow the introduction of an elevated system similar to that of New York. If the roads carried passengers only as far as the river they would be exposed to the same delays at bridges, which, while navigation is open, now prove a serious annoyance, to the residents of the west side particularly. If bridges were built at the ordinary height they would interfere with shipping. The dirt, noise and smoke, and unsightly appearance of the elevated roads are also alluded to. Mr. Stoltenberg thinks the proposition to construct the elevated road in alleys has some advantages, but the fact that costly buildings must be removed and large amounts for right of way must be paid preclude the immediate construction of such a road.

A perfect system of reliable transit can only exist, he says, where the entire road is constructed in one disinterrupted whole, for only then can the different sections of the city receive direct communication with their center and between each other.

These advantages could be best obtained by an underground road constructed under the river; but roads of this kind are always damp and poorly ventilated, so that in London the old-fashioned omnibus is preferred by many persons, even for long distances. Mr. Stoltenberg then explains his own proposition as follows: "All the before mentioned disadvantages and objections to the underground and ordinary elevated roads, can be obviated by securing elevated roads at such a height that they will permit the passage of vessels beneath them without interruption of the traffic. The highest point that would have to be reached would be about 130 feet above the high water level of the river, or 120 feet above the level of the streets, as shown in Fig. 1. Very little noise would be apparent from the operation of an elevated railway built at such an altitude, neither would the structure darken the streets. But instead of running the road through the center of the streets, we would suggest that the structure be carried above the roofs of the houses and across the blocks, although, undoubtedly, no little difficulty would be experienced in securing the right of way. But we know of no other arrangement whereby an elevated railroad that will not obstruct in any way the streets nor interfere with navigation, and that will at the same time transport passengers from the south or north or west sides, can be successfully engineered and operated. On account of the great danger in case of fire, and because the streets would be too much darkened by the structures, restrictions as to the maximum height of buildings

ELEVATION. CROSS SECTION.

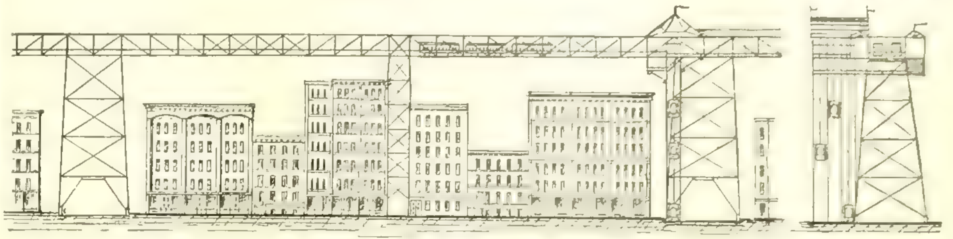


FIG. 2. RAPID TRANSIT FOR CHICAGO.

[illegible] guard rails might be [illegible]

will doubtless be introduced in Chicago in the near future. The construction of elevated railroads on this principle appears at first wild and fantastic, but on closer examination the objections relative to costs, etc., as well as danger, disappear. Although the project has been carefully examined and criticized by several competent engineers, no objections have been set forth as to the practicability of the scheme. In the northern part of New York city the elevated roads are built at an altitude nearly suitable for Chicago, owing to the unevenness of the surface, and trains run in this case in straight lines and sharp curves with the same safety as in the southern part of the city on the regular level.

PLAN.

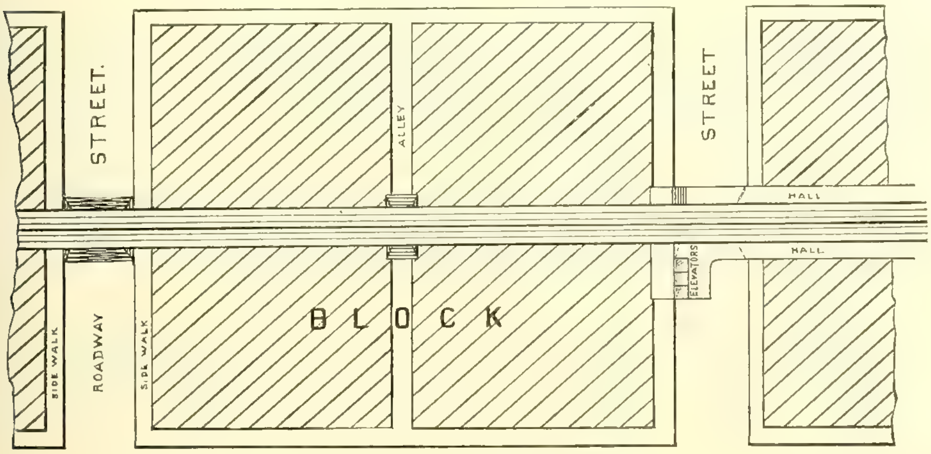


FIG. 3. RAPID TRANSIT FOR CHICAGO.

affect the total cost materially, but owing to their great convenience they would considerably increase the volume of traffic.

In the business portion of the city there should be one station to every three or four blocks, while further out one at every section or half-section street would suffice. For instance, at Canal and Halsted streets and Center and Ashland avenues, etc.

An elevated road of this description, built as an uninterrupted whole, would enable passengers to travel in every direction unmolested by navigation and without change of car, continues Mr. Stoltenberg.

Ordinary elevated roads cost, Mr. Stoltenberg says, $500,000 per mile. The cost of the structure which he proposes would be $900,000 per mile.

The enormous earnings of the New York roads are referred to. The concluding idea in the article is set forth in the following paragraph:

"The successful operation of elevated railroads in the east leaves the final merits of an investment of this kind entirely beyond doubt, as above indicated. Why should not the city of Chicago take a lesson from the eastern cities, and take upon itself the construction and equipment of elevated railways? Only when planned by the administration of the city, with the interests of the public solely in view, can the enterprise be executed in accordance with the demands of the public, and only by persons taking this higher point of view, can they be constructed in such a manner that they will prove to be for the best interests of the community at large. At the same time, the [illegible] increase in revenue gained thereby [illegible] the city to meet larger expenditures [illegible] branches of public improvements."

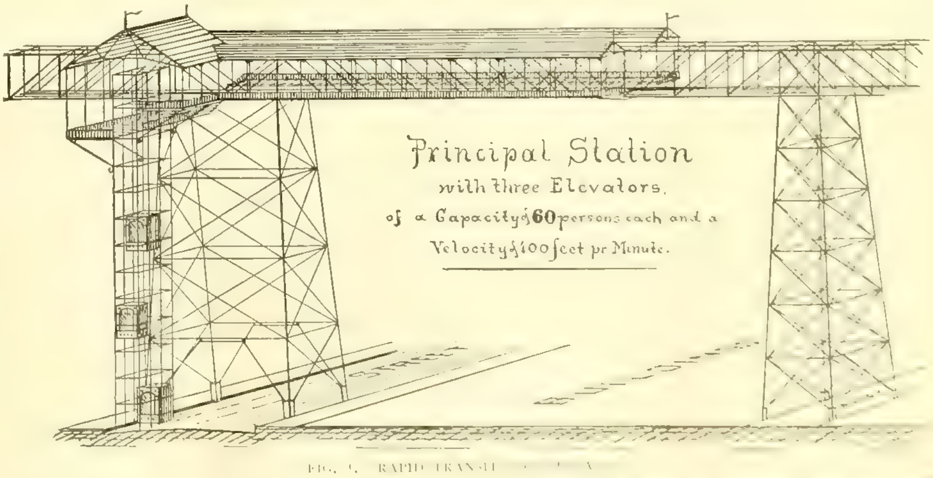


FIG. 4. RAPID TRANSIT FOR CHICAGO.

Electric Effects in a Theatre.

During last week, when the Metropolitan opera company was at the Chicago opera house, a number of pretty electric effects added brilliancy to the stage settings. Among the number was a stage anvil, which was connected in an electric circuit. The arrangement of wires is such that when the artist begins to forge a sword and pounds vigorously on the anvil a succession of brilliant sparks is produced. A rainbow was produced by the skillful arrangement of incandescent lamps behind canvas. A rather pretty effect was the "lump of gold." Within a sheil of tinsel lamps are concealed, which cause the gilt to sparkle with striking effect. Other effects were produced which illustrated the great advantage attending the use of electric lights on the stage.

Curtis Pump Pressure Regulator.

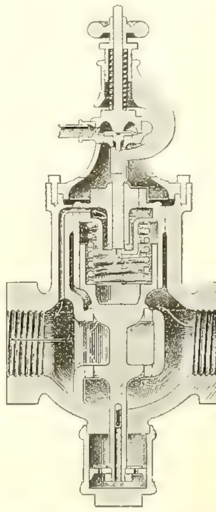
The accompanying cuts illustrate the pump pressure regulator recently introduced by the Curtis Regulator company of Boston, Mass. and the water pressure is regulated by turning down or in on the top handle of the regulator until the desired water pressure is obtained. When once set at a given pressure the pump will maintain that pressure until the handle is changed, whether much, little or no water is used. Turning down on the handle will set the regulator at a higher pressure, and turning back will set it at a lower pressure. These regulators are in general use, and are highly satisfactory.

Electric Street Railways.[1]

BY [illegible] H. WHITE.

Street railroad men should not think that electric railroading is analogous with horse car railroading, for such is not the case. The higher rates of speed which it is possible to maintain, the greater loads which it is possible to carry, and the additional weight of the motor and the running gear, ail combine to render necessary additional attention and care, not only in construction of new road but in the maintaining of old road. Experience so far, seems to have clearly demonstrated that by far a large majority of the street roads which have been equipped electrically have been done so with accompanying annoying circumstances.

Outside of the higher offices, experience has shown that the regular horse car drivers and conductors prove the best electric car drivers. Their judgment in regard to handling their car counts for more than mechanical experience on the part of others. What little mechanical skill and electrical knowledge is necessary to simply operate the car, the ordinary, intelligent horse car driver soon masters. It is, however, true, that he must exercise better judgment, give more attention to the handling of his car in looking



CURTIS PRESSURE REGULATOR

out for pedestrians and vehicles, and, in many other directions, exercise caution and control over himself.

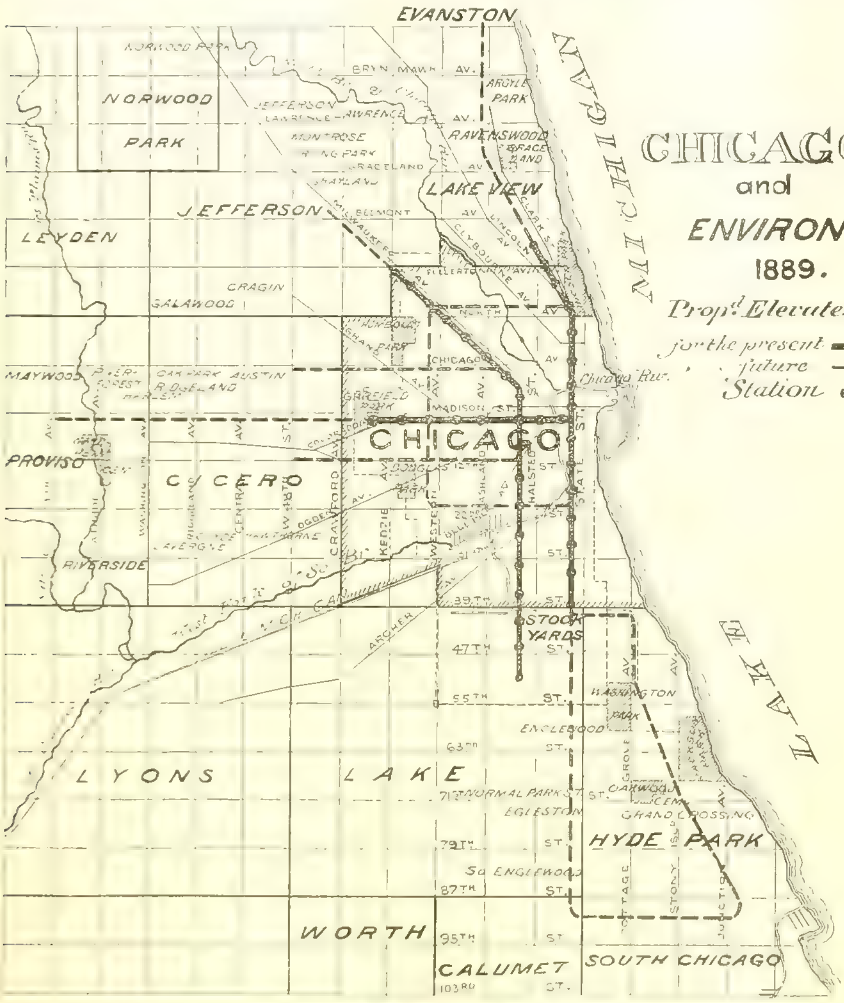
In the maintenance of the cars, naturally more skilled labor is required, and here the saving of a few dollars in wages would result disastrously. Intelligence is the prime factor and this can only be obtained by paying for it.

The superintendents, and even the managers, of electric roads, must of necessity become familiar with the details of their system, and one hundred and one small rules and details which they have mastered in the handling of their horse car system will have to be thrown aside and be supplanted by new ones attained by thought and study of the new system. In many cases, no doubt, good horse car superintendents will lose their situations, but in the general march of progress disaster is inevitably to come to some.

Throughout the entire electric system, it therefore seems, that a better class of men will be required. Whether this will have any direct influence upon the labor problems which always harass and bother street car management, I cannot say. I am inclined to think that it would have a beneficial effect.

It seems to-day as if steam railroad practice must be studied into to give valuable hints and assistance in the management and operation of the electric street roads. It does not necessarily follow that rules applicable to them are always applicable to street car systems, but a combination, rather, is what is desired.

The propelling system is mechanical, and yet the locality wherein the system is used is such that many rules governing street car propulsion must still be observed. It is, however, an upward tendency. It is the lifting of the street car business out of the lower ruts of animal power to the higher plane of mechanism.



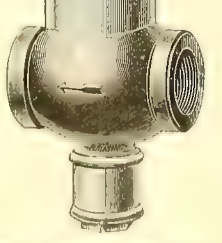
[illegible]

[illegible] iar requirements [illegible] lator, extending [illegible] shall [illegible]

The tracks have spread, sunk and curled up, and in several cases complete reconstruction was the only remedy. It must not, however, be thought that this, in all cases, is absolutely required. Throughout the country there has been the past few years a most decided improvement in track construction, and the roads which have been built within the last year or two [illegible] will stand the additional [illegible]

[illegible] that no rail of any shape [illegible] weighs at least fifty pounds per [illegible] that the tracks of a street road are [illegible] steam roads do not have [illegible] heavy vehicles in some [illegible] result of the experience of [illegible] girder rail weighing [illegible] The experience has taught [illegible] the construction of [illegible]

[illegible] be necessary to [illegible]



CURTIS PRESSURE REGULATOR.

In the tremendous increase of street car business which the electric system is destined to bring about, no expense, time, labor or care should be saved. The electric railway system of the future is to exert a most powerful influence upon the progress of the nation. In carefully examining statistics and the tendencies of the times, it seems as if the street cars were destined to play the most important part of all other industries in the development of the country.

There are to-day over forty cities having a population of over 50,000, and the general tendency of the people is toward the cities.

Since it is in the cities that the street car exerts its influence, surely it must be true that in keeping with its gradual tendency must the street car systems be improved. I venture to predict that within the next decade there will be such an extraordinary application of the electric power to the propulsion of street cars that the use of horses will be a rare sight.

In some of the largest and most conservative cities of the Union, an application has already been made by the company controlling the entire system of the city for perfect freedom in operating its cars by the electric current taken from the overhead wire. If the West End railroad of Boston get the right, and it certainly looks as if they would, the largest street railway system of the world will have endorsed the practicability and the perfection of the electric system.

Wonderful as have been the achievements of science in the present century, there seems to be nothing which will be comparable with this promised application. The most mysterious force which man has yet brought within his powers is to be applied in a common commercial way in every street of our great cities.

Every man throughout the country engaged in the street railroad business feels the tremendous impulse which this application is giving to his business, and it does not become any party to rashly predict a dismal failure.

In the words of one of America's greatest philosophers, Emerson, "Our duty is plainly not to throw ourselves across the track, not to block improvement; not to sit still until we are stone, but to watch the uprise of successive mornings and to conspire with the new works of new days."

Lamp Lighting Schedule—Moonlight System.

MAY.

Day of Month.	Light	Extinguish	Number of Hours
	H. M.	H. M.	H. M.
1	**7.30**	4.00	8 30
2	**8 30**	4 00	7 30
3	**9.20**	3.50	6 30
4	**10.10**	3.50	5 40
5	**11.00**	3.50	4 50
6	**11.50**	3.50	4.00
7	12.20	3.50	3.30
8	1.00	3.50	2.50
9	1 30	3.50	2.20
10	2.00	3.50	1 50
11	2.30	3 50	1.20
12	No	light.	0 00
13	No	light.	0.00
14	No	light.	0.00
15	**7.40**	**9.10**	1.30
16	**7.40**	**10.00**	2.20
17	**7.40**	**11.10**	3.30
18	**7.40**	12.10	4 30
19	**7 40**	1 00	5 20
20	**7.50**	1.50	6.00
21	**7.50**	2 20	6.30
22	**7.50**	2.50	7.00
23	**7.50**	3 20	7.30
24	**7.50**	3 30	7 40
25	**7.50**	3.30	7 40
26	**7.50**	3.30	7.40
27	**7.50**	3.30	7 40
28	**7.50**	3.30	7 40
29	**7.50**	3.30	7.40
30	**7 50**	3 30	7.40
31	**8.10**	3 30	7 20
Total number of hours,			154.00

The foregoing schedule is practically good for the United States.

The time for commencing to light is calculated at one half hour after sunset, or one hour before moonset, the time for extinguishment one hour after moonrise, or one hour before sunrise.

The time for lighting or extinguishing is given for the day on which the night commences.

The time up to 12 o'clock midnight is shown by bold face type, after midnight by light face type.

The Hawkeye Electric Company.

The Hawkeye Electric Manufacturing company of Davenport, Ia., is now officered as follows: President, Maj. M. L. Marks; vice-president, E. P. Lynch; secretary, Lee E Cole; treasurer, Walter Chambers; general manager, William Bowen; electrician and superintendent of the shops, Frank Thone The directors of the company also include: James P. Thompson, president of the First National Bank; L. P. Best, general manager of the Glucose Manufacturing company; Jens Lorenzen, wholesale crockery merchant, and James P. Donahue, vice-president of the Waterworks company. The company was incorporated Oct. 26, 1888, succeeding the Hawkeye Electric company of Oskaloosa. Since its incorporation the company has moved its shops to Davenport, where it has a large and commodious factory with all the latest improved machinery for manufacturing dynamos, motors, lamps, sockets, wall switches and other improved devices for electric lighting and power, all of which are made under patents granted to Mr. Thone. The company has made installations at Montezuma, Storm Lake, Muscatine, Davenport Ia.; St. Louis and Kansas City, Mo.; Horton, Kan., Havana, Cuba. The company has introduced several plants in New York city, and has recently completed a large installation for J. B. Clow & Son of Chicago. The corporation has on hand a number of very large contracts, including a large power plant at Denver, a 50 horse power dynamo for the Electric Street Railway company of Des Moines, and motors in Des Moines aggregating over 40 horse power. It has also in process of installation large power plants in St. Paul and in Kansas City. An installation of 350 incandescent lights at Reed Springs hotel, near Kansas City, has just been completed. The company has just finished a fine installation at the Kimball house in Davenport. [illegible] the hotel is supplied with two or more [illegible] while in the office, parlor, dining room and halls the [illegible] produced by the [illegible]-candle power lamps [illegible] of the house [illegible]. On last Friday evening the current was turned on for the first time in the [illegible] opera house, which adjoins the Kimball house on the [illegible]. The entire theater is lighted from current supplied [illegible] Kimball house plant. The fifty lights in the dome are arranged in eight groups of five lights each, the center of the dome being lighted by a cluster of ten lamps. There are eight 16-candle power lamps in the upper gallery along the wall, fifteen 16-candle power lamps on the front of the upper gallery, ten lamps along the wall in the rear of the lower gallery. Four 3-light brackets light the stage from the sides, while there are eighteen foot lights, fifteen in the flies, twelve in the dressing rooms, besides some twenty-five more below the stage in the hallway and around the entrance of the building. The lights are very finely displayed, and the effect produced by the illumination is very fine indeed, and reflects credit on Mr Thone who has given the wiring of the building his especial attention. The rheostat for controlling the stage lights is circular in form, and contains seventy coils of wire The current for the entire installation in the Kimball house and opera house is furnished by two 225 light incandescent dynamos of the Hawkeye make, driven by a Meyer 40 horse power automatic high-speed engine. All the switches, voltmeters, ammeters, sockets and other appliances used in the installation were made by the Hawkeye company under Mr. Thone's patents The lamps are furnished by the Mather and Sawyer-Man companies For sometime past a 4 horse power Hawkeye motor has been in use in N. Kuhnen's cigar factory, where it runs four cigar-making machines Owing to its perfectly uniform speed, it is especially adapted to this class of work The new printing and lithographing house of Edbert, Fidler & Chambers will be run by one 10-horse power and one 3-horse power motor of the Thone type, the current being taken from the street car company's plant.

The Hawkeye company has just secured a contract for lighting the streets of Pierre, Dak. The installation consists of a steam plant complete, 50-horse power engine and boiler capable of carrying eighty pounds of steam, one Thone improved arc light dynamo with fifteen arc lamps, five miles of arc light lines, one Thone incandescent automatic dynamo capable of running 300 16-candle power lights, with all the necessary appliances and wiring for delivering light and power to public buildings, and also to private individuals.

CORRESPONDENCE.

New York Notes.

NEW YORK, April 27.—Mayor Grant is displaying rare qualities as a fighter in his controversy with the electric light, telegraph and telephone companies in this city, and he is surprising his friends as well as his opponents by his tenacity. Just now he is impressing the Board of Electrical Control as well as the electric companies with the fact that he has ideas of his own respecting this question, and he proposes to see that they are executed. The telegraph, telephone and electric light companies have come to the conclusion that there is no hope for a compromise, and they are accordingly making the best of the situation, saving as much wire as possible. In this race between the companies and the city the best interests of the taxpayers will be served, the wires will soon be down, and the work of operating in the subways will be accomplished. The mayor is very bitter in his opposition to the electric companies. He says that he will not vote to grant permits to any company that has not shown a disposition to comply with the law. The assembly committee on cities has agreed to report favorably upon the bill giving the commissioner of public works of New York power to remove poles and electric wires from the streets at the expense of the companies operating them.

The mayor's first order in reference to the removal of poles and wires has been executed. Not a pole remains on Sixth avenue between Twenty-third and Fifty-eighth streets; Broadway between Forty fifth and Twenty-third streets; Fifty-eighth street has been cleared between Fourth and Sixth avenues; Forty-second street between Madison and Sixth avenues, and Twenty-third street between Fifth and Sixth avenues is cleared of all but the telephone poles. When Mayor Grant was informed of the progress made Tuesday he issued the following order to the commissioner of public works: "You are hereby directed to remove forthwith from Broadway, beginning at Park place, all the poles and wires of telegraph and telephone companies to Fourteenth street, and from Fourteenth street to Fifty-eighth street all poles and wires except the poles and wires of the fire department." The reason electric light wires are not mentioned in this order is that the conduits are not ready to receive them in the lower part of Broadway.

While a gang of "choppers" were at work Thursday afternoon on Broadway they were reminded of their danger and immediately desisted. While one of the workmen was on a pole a United States Electric Light company's wire was brought near a dead Western Union company's wire, and the electric light wire grounded on the telegraph wire A flash passed from the electric light wire to the telegraph [illegible]

avenue, all poles and wires.

[illegible]

The [illegible] Electric Lighting company's [illegible] burned this week. The machinery was almost entirely destroyed.

After two days of trial the United States Illuminating company yesterday effected a compromise [illegible] $[illegible] damages brought against it by [illegible] Shillings [illegible] was [illegible] January, 1886, on the elevated structure at Park place and Church street. He came in contact [illegible] sustaining a shock which doubled him up. After writhing for a while he fell to the street, injuring [illegible] hand was badly burned.

Considerable interest has been manifested in telegraph circles over the reported deal between the Western Union and United Lines, which, it is said, will go into effect May 1st. The report says: The terms have been reduced to writing, signed by the proper officers of both companies, and a forfeit is in the vaults of the Chemical bank. The deal was hastened to a consummation by the vigor with which the United Lines people invaded the South. They are at present constructing in that field, so long exclusively Jay Gould's, an average of ten miles of line a day—one line extending from St. Louis to New Orleans, one from Indianapolis to Atlanta via Louisville, Nashville and Knoxville, and one from New York to Galveston via Richmond, Charleston and Savannah to New Orleans. This line is intended to secure the big cotton cable business of the South.

When away from New York recently, it is said, Jay Gould and W. B. Chandler of the United Lines met and arranged the final details of the compact. This instrument provides that, beginning May 1st, all rates to common points shall be equal by both lines, the company now having the lower rate to raise its tariff to correspond with the higher. The Mutual Union company, which has been used by the Western Union company to cut rates with, shall pass forever out of existence. As a distinct corporation it has been dead for several years, but the Western Union has maintained the Mutual in all large cities. Special orders have been given to remove the Mutual signs and close the offices April 30th. No cable cuts are to be made. Local offices are to give each other credit. It is specially stipulated that each company shall make an extra effort to prevent any ideas of the consolidation or monopoly. Since the Pennsylvania law, under which the Mutual Union was incorporated, stipulates that all offices shall perpetually be maintained in that state, both companies will unite to maintain two offices. The messenger companies are not to be used to injure the other's business. One company receiving a message for points not on its lines delivers them to the other.

It is also stipulated that neither company shall [illegible] any lines, not now building or under contract [illegible] May 1, 18[illegible], except by mutual consent. [illegible] leased lines are to be raised, and equal [illegible] the press. Joint meetings of the governing officers are to be held quarterly. None of the present employes are to be discharged. Separate offices must be [illegible] local managers are forbidden to appear [illegible].

The Julien Electric Traction company is [illegible] with its system of electric cars in [illegible]. The latest report shows a steady gain in [illegible]. The advantage of the steady electric light [illegible] sought by those who ride in street [illegible]. The mayor of Providence, some of the aldermen and Mr. [illegible] lett, general manager of the Union [illegible] Providence were at New York last Saturday [illegible] working of the Julien cars on Madison avenue. [illegible] so well satisfied with the result of [illegible] they [illegible] cars from the Julien company [illegible]

street railway. [illegible] Boston were here Monday [illegible] their satisfaction with the Julien system for crowded thoroughfares. The thirty cars which the John Stephenson company is building [illegible] completed about May 1st.

The annual meeting of the American Institute of Electrical Engineers for the election of officers for the ensuing year and the transaction of other business will be held at the house of the American Society of Civil Engineers at 127 East Twenty-third street, New York, on Tuesday evening, May 21st [illegible]. The morning session of the general meeting for the reading and discussion of professional papers will be held at the same place, beginning at [illegible] M. [illegible] served at 1 P. M., after which the meeting will then reassemble for the afternoon session at [illegible] the City of New York, 17 Lexington avenue, where suitable electrical apparatus will be provided for experiments. The following papers will be read [illegible] "Modern Views as to the Nature of the Electric Current," with experiments by Prof. H. A. Rowland; "The Inherent Defects of Lead Storage Batteries," by Dr. Louis Duncan; "The Regulation of Dynamos and Motors," by Dr. Schuyler S. Wheeler; "The Measurement of Telephonic Currents," by Prof. Chas. R. Cross; "A Series of Tests on the Life and Efficiency of Incandescent Lamps," by W. H. Pierce of the C. B. & [illegible] "Some Results with Storage Batteries in Train Lighting," by Alexander S. Brown of the P. R. R.

W. H. T.

Louisville, Ky.

LOUISVILLE, April 30.—Work on the Louisville electric railway was begun more than twelve months ago, and a five mile double track soon connected the eastern and western limits of the city. In spite of obstacles thrown in the way by injunction suits, a large force of laborers pushed the work through to supposed completion. The track was down and all the pavement was replaced, when it occurred to the constructing company that wires connecting the rails would be necessary. The street was torn up again, and much time was lost. However, the tracks have now been ready for the cars for several months, but the trucks could not be obtained, as the manufacturers were overrun with orders. The trucks have been received, and everything is now in readiness for operation. The new road is to traverse Green street from east to west, nearly parallel with the river.

The Louisville Electric Light company has just placed in position two Westinghouse alternating machines of 750 lights capacity each

The first application of electricity to ventilating purposes in this [illegible] the Louisville Banking [illegible]. The [illegible] Electric company is now engaged in installing the apparatus.

[illegible] improvements in its [illegible]

[illegible] company is installing a Western [illegible] purpose of lighting the [illegible] pumping station. Eight lights [illegible]

[illegible] last week with a [illegible] Edison phono[illegible] the state of Ken[illegible] [illegible]ment of instruments, which is to [illegible] The [illegible] has [illegible]

[illegible] teep in- [illegible]

[illegible]

been used. Before long no telephone wires will be overhead in the principal thoroughfares.

W. H. Johnson was re-elected inspector of electric lights at the last meeting of the city council.

A.

St. Louis, Mo.

ST. LOUIS, April 27.—In the municipal assembly Tuesday night, a bill was introduced authorizing the Broadway and Seventh Street Railway company to construct an elevated road from Meramec street and Broadway north on Broadway to Seventh street, thence north on Seventh to Broadway again, and thence north on Broadway and the Bellefontaine road to Calvary cemetery, the line to be operated by cable, steam or electricity.

The preparations for the electrical display at the Exposition are on a much more extensive scale than is generally believed, and the managers of this department evidently mean to make it a noteworthy success. The entire north nave will be devoted to the exhibit of electrical devices, which it is expected will cover the entire field of electrical development. The booking of exhibits and assignment of space for the electrical department of the Exposition is in the hands of D. J. Harris of the Western Accumulator company, who has been detailed for this work by W. S. Rogers, local manager for the company, at the request of the Exposition management. There will be many novelties displayed in Exposition hall. Among these will be the phonograph and writing telegraph. The Electrical Storage Battery Accumulator company has arranged to exhibit a road wagon propelled by a dynamo and one of the accumulator batteries. The New York Accumulator company will also show its various electrical illuminating and power appliances in full operation. W. W. Griscom, of Philadelphia, who is connected with the St. Louis and New York companies is arranging to place an electrical street car system in the Exposition, and also to get electric cars placed on various street railroads. He is holding daily conferences with the Exposition management and with the street railway people for this purpose. John Stephenson, the New York street car builder, is also arranging for similar privileges, and both parties will be represented by a long line of most interesting electrical apparatus Five thousand square feet of space have been taken by Ernest J. Bagnall, superintendent of the St. Louis Brush Electric Lighting company, and he will fill it with his own and eastern exhibits which he will secure. The Bunnell Electric Manufacturing company of New York has contracted for 10-horse power and space for the exhibition of a complete set of telegraphic apparatus and appliances. It will also bring several dynamos and motors. The Schuyler company of Middletown, Conn., will use 500 square feet of space and 100-horse power in showing electric lighting apparatus. The Heisler company of St. Louis will show a duplicate of its electric plant operated at the Paris Exposition. The West Side Electric Light & Power company of New York has arranged to exhibit a complete electric lighting plant, and to demonstrate practically the transmission of electric power. This company will also show a complete set of testing and indicating apparatus. F. M. Sporrow, of Boston, will exhibit automatic electric devices for regulating the supply in steam heating apparatus. The National Carbon company of Cleveland, O., will exhibit carbons for arc lights. The Hawkeye Manufacturing company of Davenport, Ia., will show its electric lighting system. The Elgin, Ill., Telephone company will exhibit its short-distance telephone. The Detroit Electrical Works will show its dynamos, motors and other electrical appliances Exhibits will also be given by the American Watch Tool company, by the American Electrical Regulator company, by the American Electric Motor company, and other similar concerns.

The Missouri Bell Telephone company has been asked [illegible] switch board and exhibit the [illegible] interchange of messages is effected, [illegible]

[illegible] number of large foreign elec[illegible] testing devices for exhibi[illegible] Telephone system will be exhibited. [illegible] London Eng and a number of [illegible] presented

McI.

Philadelphia, Pa.

[illegible] There are numerous [illegible] [illegible] are so high [illegible] others will not adopt the [illegible] mean the sale of [illegible] in the city [illegible] [illegible] Wilkesbarre, where [illegible] rate per hour [illegible] [illegible] month for [illegible]

The question which exercises the public mind is rapid transit. The city extends over such a vast area that residents in the suburbs are constantly knocking at the doors of councils for the adoption of some method whereby they can get to their places of business in a reasonable time.

There is very little disposition on the part of the street car companies to adopt the electric system. Perhaps they desire to keep up the reputation of the city for slowness. It is the general opinion that the demands of the people will compel companies to adopt the only favorable and cheap locomotion- -electric motor power.

A new car recently put in commission by the Traction company for the use of the Electro-Dynamic company, and operated by electricity, makes almost daily trips between the Forty-ninth street depot and Darby, about five miles. The car resembles, in many respects, the one used by the Ridge Avenue company about a year ago, but the machinery has been considerably modified and other objections overcome, so that the car is about as perfect as may be expected for the uses for which it is intended. Storage batteries are used as the source of power.

The Central Electric company has about 100 houses under contract to wire.

The Bell Telephone company will at no distant time have all its wires underground. The system acts admirably. The company has commenced the erection of its new building on Market streat, above Fourth. It will be four stories high, and the top story will be used for the telephone exchange.

H. A. Cleverly of the Cleverly Electric Light works has a patent upon a new automatic burner which requires but one ordinary desk button to light and put out. This establishment also has a patent new ratchet burner.

D.

San Francisco, Cal.

SAN FRANCISCO, April 20.—The Willamette Falls Electric company of Portland, Ore., has contracted with the city of Portland to furnish 31 arc lights at $15 each pe month, and 730 incandescent lamps for a total of $1,782.62 per month. The contract will run for two years.

A new electric light company has been incorporated at Vallejo for furnishing lights at Vallejo and Mare Island, but the committee appointed for purchasing apparatus has not yet decided on a system.

The Sprague company has received the contract for equipping an electric road one and three quarter miles long, and using five cars, for the Willamette Bridge Railroad company of Portland, Ore.

The city council of Berkley, Cal , is contemplating an enlargement of the city electric light plant, and is making provisions for placing the necessary bonds.

The Electric Improvement company is installing a 1,000 light Slattery alternating plant at the Palace hotel, San Francisco.

The Brush Electric Light company of Eureka, Cal., has received the contract for lighting that city.

The Mather Electric company has almost completed the wiring of the new California theater, having had a force of eighteen men, under the supervision of W. Thomas of Chicago, hard at work for the last three weeks. Grimshaw wire is used throughout. Payne engines and Root boilers furnish the power. The theater will be opened May 13th.

L. P. St. Claire of Bakersfield, Cal., has been granted a franchise for electric lights.

Electric railroads are booming in Los Angeles. The Pico street company has been given permission to change its system, and the Vernon street company will soon contract for an electric system.

The Pacific Electrical Storage company has contracted for lighting the state insane asylum at Reno, Nev., with 100 lights, using a United States dynamo for charging. The power will be furnished by a Pelton wheel.

The Pacific Postal Telegraph company expects to have a wire in Los Angeles within two weeks.

The authorities of the city of Fresno are contemplating a fire alarm system for that city.

S. H. Taylor, general agent for the Thomson-Houston company, has left for an extended trip through the east.

The Thomson-Houston company has received the contract for wiring the addition to the Hughes hotel, Fresno, for 300 lights.

The Pasadena Electric Light & Power company has received the contract for city lighting.

The California Electrical works of San Francisco has sued for an injunction restraining George L. Henzel from infringing on their gas lighting apparatus.

The Thomson-Houston company has completed installing 100 lights in Sperry & Co.'s flour mills at Stockton, and also 500 lights at the Hotel Peralta at Berkley, Cal.

The Oakland Gas Light & Heat company is moving into its new station, which is one of the most substantial buildings used for the purpose on the coast. The power

will be furnished by a Hamilton Corliss tandem compound engine of 500 horse power, one Meyer cut-off engine and one Armington & Sims engine; Hill clutch pulleys will be used throughout. Thomson-Houston arc and two 750 light Westinghouse dynamos are used.

The Stockton Gas company is installing a 600 light slattery alternating plant, and is increasing its city lighting by ix lights.

The Westinghouse company is installing a 750 light plant for the Southern Pacific Railroad company at the latter's shops at Sacramento.

The San Louis Obispio Electric Light compa ny is installing a 600 light alternating dynamo of the Thomson Houston system.

The California Electric Light company is making preparations for moving into its new station. The company will install a large plant of the new Brush alternating system.

Joseph L Jayne, agent for the Sprague company, addressed the San Francisco Electric society last Monday night on "Electro-Motors and the Transmission of Electric Power." The society now numbers nearly 100 members, and is constantly adding to its list.

The town of Pomona wants electric lights, and the citizens are endeavoring to form a company to supply the demand. W. G. C.

THE ELECTRIC LIGHT.

The Fountain City Electric Light company of Bryan, O., has been organized with $30,000 capital stock

The Brooklyn Electric Light company has obtained a temporary injunction restraining the mayor and the board of city works from interfering with its operations.

The incorporation is announced of the Franklin Electric company at Chicago, capital stock $5,000, for the manufacture of electrical supplies and appurtenances; incorporators, E. E. Flora, Philo R. Hoy and Edward J. Tooze.

The Light & Fuel company of the city of Bloomington, Ill.—capital stock, $15,000—has been formed to furnish light and fuel to the citizens of Bloomington and Normal; incorporators, James A. Wilcox, G. W. Funk, and T. F. Harwood.

The Pana, Ill., Electric Light company—capital stock, $10,000—has been incorporated to construct and operate an electric light plant; incorporators, A. B. Corman, L. Schlierbach, Robert Johns, William H. Newcomb, and George V. Purcell.

A dispatch from Tiffin, O., dated April 20th, says: This has been a great evening for Tiffin. The city was illuminated for the first time throughout by electric light, the new plant being finished to-day. Brass bands were out, and thousands of people were on the street.

Springfield, Mass., will have electric lights for its streets. The city council has decided to award the contract for 300 arc lights to the United States company, reserving the privilege of increasing the number at any time at the contract price, $83.33⅓ per light per year. The contract will be for five years.

The Rocky Fork Town Electric company has been organized at Helena, Mont., with a capital of $1,000,000, to operate in the new country just opened up by the Rocky Fork branch of the Northern Pacific. The incorporators are S. T. Hauser, Samuel Ward, H. Barbour, I. L. Platt and John W. Buskett

Among the recent sales of the Western Electric company of Chicago are the following: Belknap & Dumesnil Stone company, Louisville, Ky., 1 6-light arc plant, low tension system; Ashland Iron Mining company, Ashland, Wis., 1 12-light low tension arc plant; Forristal Crematory & Garbage Works, Milwaukee, Wis., 100 light incandescent outfit, complete.

A Minneapolis paper contains the following: "The special council committee on conduits considered that knotty problem again yesterday. Ordinances for the Thomson-Houston and Edison companies were submitted for approval. The Thomson-Houston people agree to put their wires in the Dorsett conduits as fast as the system can be extended. This ordinance conflicts with the city ordinance in that the latter does not allow the erection of poles inside the fire limits. The ordinance submitted by the Edison people conflicts in one particular—that it applies to territory outside of the four-foot limit.

At a recent session of the board of trade in London, Mr. Ferranti gave the following information concerning the Deptford Station: Excavations covering a space of 200 feet square were made, and in that buildings were erected to contain the plant capable of working up to 40,000 horse power. They had just completed the erection of two engines, each of 1,500-horse power. Two larger engines, each of 10,000-horse power, are now being erected. He had seen one of the engines of 1,500-horse power running, and believed the second had been running as well. Each of those sets of engines is easily capable of generating electricity for 25,000 lamps of 10-candle power. In November next there will be a 10,000 horse power dynamo ready and another of a similar size in December, when the machinery will be capable of an output of 250,000 lamps. The company have also contracted for erecting further plant, which will give, with that already spoken of, a total output of 450,000 lights. He saw nothing remarkable or extraordinary in the size of the engines of the company; in fact, he was rather disappointed that they had not got larger engines, considering the way steamships had increased the size of theirs. They were going to lay down six mains with concentric conductors between the Deptford generating station and the distributing station in London from Deptford to London bridge. They were carried in brackets along the railway. These cast-iron brackets are provided with India rubber or porcelain supports, on which the cables can be laid Each main will carry 100,000 ten candle lamps, so that there will be a carrying capacity of 600,000 lights, although it is not intended to work up to that capacity. In the first place, there will be an enormous margin in the mains. Later on it may be found desirable to have less, but it is always proposed to have a considerable margin in the mains. The mains are so arranged that any one of them may be thrown into connection with any other of them at Deptford, so that to have a total failure of lighting there must be a total breakdown of both engines and mains at the same time. There will be two mains at least in each distributing station, supplied from two separate dynamos, so that the supply is in duplicate, and to have a failure of current from the di tributing station both the sources would have to fail. If one only failed from any cause, the other would be of ample capacity to supply the whole demand. In the event of a breakdown in the converter the current would be thrown over by a switch to the other supply, and the converter itself will be cut out by its own fuses automatically. The loss of potential in the Deptford trunk mains he calculated to be one-fifth per cent. per mile run. With respect to the insulation between the inner and outer conductors, he had tested the insulating capacity in a number of lengths up to 1,000,000 volts without getting through or injuring insulation in any way; therefore, with the pressure at which it was proposed to work that would give a safety margin of 100 to 1

THE TELEPHONE.

The railroad committee of the Michigan senate has reported adversely on the Wisner bill to reduce the rental charges for telephones to $2.50 and $3 per month, and the bill was tabled.

An ordinance granting the Chicago Telephone company the right to erect poles and maintain and operate telephone lines along the public roads of the county outside of incorporated cities, towns and villages, under such regulations as the board may prescribe, has been recommended for adoption by the Cook county board.

The Paris Telephone company, which owns the Edison carbon transmitter patent in France, began an action against several infringers. The Tribunal de la Seine decided that the carbon transmitters in question were no infringement on the Edison patent. The action of the Paris Telephone company was dismissed, and the Edison patent for the carbon transmitter on the continent appeared thus to be valueless, says an English paper. This decision will no doubt have a great influence on other tribunals on the continent. In Belgium the Edison-Gower-Bell company, together with the Consolidated Telephone Construction & Maintenance company, both of London, commenced a similar suit in 1886 against the different Bell telephone companies as supposed infringers of the Edison patent, but thus far there has been no decision.

THE ELECTRIC MOTOR.

Work will be commenced at once on the electric street railway at Warren, Pa.

The Waterloo, Ia., street-car company is making arrangements to run its cars by electricity.

Work has been begun on the new electric street railway to be operated from Attleboro to Plainville, through North Attleboro, Mass , at the northern terminus toward North Attleboro.

Boston city officials and electrical experts have been examining the experiments in New York, Cincinnati, Detroit, Cleveland and other cities, in the matter of adopting electricity for propelling street cars.

The Omaha Electric Motor company is making rapid strides in completing the work on its new lines. Judge Doane has denied the applications for injunctions restraining the company from proceeding, and before many days its work of extending tracks will be completed.

The Sprague Electric Railway & Motor company has received orders during the week for twenty cars and ten miles of roadway, for St. Joseph, Mo. All the St. Joseph street car lines are now equipped with the Sprague system and they are giving entire satisfaction, in fact the old lines have ordered additional cars.

A Decatur, Ill., dispatch says: The Decatur Electric company has commenced laying two miles of street railway track, and will put in a plant to cost $100,000. Detroit and Louisville capitalists are furnishing the money. The Citizens' company, operated by Decatur capital, will run its street cars by electricity by July 4th.

The Rodondo, Cal., Railway company has been organized, with a capital stock of $500,000. The directors are J. G. Ainsworth and H. H. Thompson of Oakland, and W. H. Bonsall, L. T. Garnsey, S. O. Brown and D. McFarland of Los Angeles. The company represents $10,000,000 capital, and the directors are determined to make it a success. The Los Angeles electric railway has been purchased by this company, and will be extended to Redondo.

A press dispatch of last Saturday from Des Moines, Ia., says: The sale of the Des Moines Street Railway company's lines to a Cincinnati syndicate is announced to-day. The principal purchaser is George B. Kerper, who is at the head of one of the cable roads of Cincinnati. It is understood that the syndicate that takes the road is composed of Standard Oil people, who are largely interested in street railways in several cities. The road at present has the [illegible]

[illegible] ductor [illegible] Sprague patented [illegible]

Miscellaneous Notes.

At the meeting of the Electrical Society of Buffalo [illegible] 10th, Frank G. Rattle [illegible] of the Thomson-Houston [illegible] presented a paper on arc lights. He [illegible] ... for illumination, and gave a [illegible] experiments

An electrical apparatus for warning travelers of an approaching train at unguarded road crossings has been adopted by German and Holland railroad companies. By an electrical arrangement a bell begins to ring [illegible] the crossing when the train is 1,500 yards therefrom, and continues r'nging until the train has passed. The apparatus is particularly intended for the light or second-class railways in Germany.

An opinion was handed down last week by the judges of the Appellate court, Chicago, in the case of the Callender Insulating & Waterproofing company, of New York, against Alpheus C. Badger, an action growing out of differences of opinion in regard to the value of a quantity of wire. It was conceded that the same considerations governed this case as in the suit of the appellant company against Sherman S. Badger, and the judgment of the lower court in favor of Badger was affirmed

A Boston dispatch says: "It is learned from a private letter from Paris that the American representatives to the conference which is endeavoring to straighten out the copper situation desire to fix the price of the metal at from £40 to £45 per ton. The Rio Tinto people want £35, and the bankers interested desire as much as £50. There are hopes of having the accumulated supply of copper held for six months, and curtailing the output. M. Secretan attributes the collapse of the syndicate to the bankers, who insisted on a high price for copper."

The following dispatch was sent from New Brunswick, Me.: M. L. Hussey of Menlo Park employed A. F. W. Mueller of this place, recently, to make a peculiar balance wheel, suitable for an electric watch. The wheel was completed yesterday, and it was exactly the thing that Mr. Hussey had long wanted. Mr. Hussey said to night that he was a friend of Edison, and for eleven years had been experimenting on clocks and watches, with the idea of running them by electricity The motor for watches is in a metallic case, which is about an inch long and is attached to the watch by a chain, which may be of any metal, but which is so constructed as to carry the current Prof Van Dyck of Rutgers college thinks the invention valuable.

Another inventive genius has turned his attention to the subject of harnessing Niagara. His name is D. N. Long, of Williamsville, Ontario, and his scheme proposes not only to furnish power, but also drainage for the city of Buffalo By his scheme he proposes to furnish light for the city by means of electricity, also power for eighteen miles. About fifteen miles will be a surface ditch, and three miles a tunnel. The tunnel portion will be at the falls, and the southern section will be used for motors, etc. The Buffalo & Niagara Water Power & Drainage company has been organized to carry the scheme into effect, and the New York legislature has been asked for a charter. The capital stock is $5,000,000, and half that, it is stated, will be used to build the ditches and tunnels. It is planned to have all the trunk sewers in Buffalo empty into the channel.

Many novelties in the way of phonographic toys have been recently produced, and others are now being prepared. M. P. Handy, the European manager, recently said: "Much more interesting than the phonographic animals are the phonographic birds, we have [illegible] melodies of the lark, the linnet, finch, robin and [illegible] bird, and can reproduce them indefinitely. With [illegible] birds the success is notable. We have preserved in [illegible] the entire repertoire of a number of the finest [illegible] highest priced birds in the market, and by combining the song of two or three into one whole, we have an artificial canary that will out sing any natural one whatever. The phonographic orchestra and the phonographic [illegible] theater are other novelties to be soon produced. In the former a band of little images, dressed in [illegible] military colors, are seated on the stage as in a [illegible] concert, or stood around a drum-major as in a [illegible] The moment the phonograph is set going, [illegible] moves his hands and instruments the [illegible] the cylinder inside reproduces the music [illegible] with startling fidelity. In the theater we can [illegible] the spoken parts of the play. Another novelty that is [illegible] a toy and half a luxury will be a great boon [illegible] whose young children insist on being sung [illegible] to sleep. It is a phonograph into which a [illegible] her best songs at her leisure, and which [illegible] crib or cradle. A mere touch upon a spring starts [illegible]

[illegible] as he or she [illegible] phonograph is the [illegible] be increased the pitch of the voice it reproduces is heightened, and on the other hand if it be slowed the pitch is lowered. At the [illegible] not changed in the least. This odd peculiarity enables a man to hear how [illegible] a high tenor like [illegible] been born a basso [illegible]

A dispatch of April 23d from Dallas, Tex., says: T. L. Manigan, a plumber, who recently came here from Memphis, Tenn. [illegible] of Tozier & Mc [illegible] in the engine room of the Windsor Hotel. A new pump was being placed in the engine room to be run by a dynamo instead of steam, [illegible] Manigan was standing on the pumping machine connecting the pipe from the tank with that of the pump. While thus engaged he lost his balance, and to keep from falling he unconsciously grasped two arc light wires just above his head, [illegible] and thrown violently against the ceiling, from which he fell to the floor and expired within five minutes. He did not lose consciousness. As soon as he had fallen to the floor he remarked to the engineer: "I guess I am a dead man." These were the [illegible] words he spoke. Medical aid was instantly summoned, but nothing could be done to save the poor fellow's life.

THE TELEGRAPH.

While George Kennan was in Cincinnati a week ago he [illegible] C. W. Price of New York, who was [illegible] with Kennan in the [illegible] expedition through Siberia. Both men were expert telegraphers, and their trip was in the interest of capitalists in this country, who [illegible] the two continents by telegraph by way of Behring straits. This was before the successful laying of the cable. At the end of the trip Price and Kennan separated, and had not seen each other since. Price is now engaged in electric street railways, and Kennan's career is too well known to require recounting. It is scarcely necessary to say that the meeting, after so many years, was thoroughly enjoyed by both.

Personal Paragraphs.

George Cutter of Chicago left for Boston on a business trip last week.

F. E. Pettingell of Pettingell, Andrews & Co. of Boston, was in Chicago last week.

C. C. Warren has resigned his position with the Thomson-Houston Electric company.

Dr. A. F. Mason of the Simplex Electrical company of Boston was in Chicago last week.

Francis W. Parker of Chicago will be at the Paris Exposition during the summer. His address will be Box 100, Section, Produits Divers.

Daniel B. Stedman, jr., has retired from the Chicago department of the Thomson-Houston company, and will [illegible] in Boston. B. E. Sunny and John L. Martin will direct Mr. Stedman's department in addition [illegible]

A press dispatch from Paris says: Thomas A. Edison, who has come to Paris to superintend the arrangements for his exhibit of electrical appliances at the coming exhibition, [illegible] by President [illegible] had a number of in[illegible]

Business Mention.

[illegible] has opened a Chicago office [illegible] Armour is agent.

[illegible] Cable company is kept running night and day to supply cable for [illegible]

[illegible]

The new incandescent system of the Western Electric company [illegible] illustrated in a new catalogue. In addition to other cuts, views of the New York and Chicago [illegible]

Electrical Patents.

[illegible] 1889.

401,732. [illegible] Phonographs or Telephones. [illegible] Brooklyn, N. Y.

401,743. Telephone Transmitter. Webster Gillett, St. John, New [illegible] Canada.

401,744. Secondary [illegible] William W. Griscom, Haverford College, Pa.

The invention has particular reference to the arrangement of the plates in the cell whereby they are supported free from the bottom, so that one element may be removed without disturbing the other, and so that the plates may be held at a uniform distance from one another.

The last claim reads: "6. An electrical connector for uniting two cells of battery, consisting of two complementary sections of conducting material connected, respectively, to two battery elements and united to form a cone or cylinder having a smooth surface, guides upon the meeting surfaces to produce accurate registry, and a suitable device for clamping or holding the sections together."

401,761. Combined Motor and Electric Generator. Jabea F. Shawhan, Dayton, Ohio.

401,789. Burglar Alarm and Testing System. Frank H. Nutter, Malden, Mass.

Every wire of the system by means of this invention may be tested either silently or audibly.

401,796. Electric Railway System. Sidney H. Short, Columbus, Ohio.

Claim 2 follows: "In an electric railway system of overhead conductors, the combination of two posts, a chord connecting the upper portions of the posts, tie rods connecting the chord and posts, insulated hangers supported upon the chord and ties, cables supported upon the chord, a second set of insulated hangers suspended from the cables, and conductors supported upon the hangers."

401,797. System of Elevated Conductors for Electric Railways. Sidney H. Short, Columbus, Ohio.

The invention relates to the means of forming a connection between the elevated conductors and the electric car.

401,801. Commutating Device. David W. Thompson, Englewood, Ill.

The invention relates to improvements in commutators and brushes, more especially intended for use in temperature regulating apparatus of that class embracing a valve or damper, the opening or closing of which affects the temperature of a room or apartment, a motor actuating the said valve or damper, a thermostat, and electrical connections between the thermostat and the motor, whereby the latter is controlled from the former.

Claim 1 reads: "The combination of a commutator consisting of a cylindric metal body having insulating sections extending radially outward beyond the cylindric surface of the body, and brushes bearing upon said commutator."

401,803. Electric Meter. Elihu Thomson, Lynn, Mass.

The invention consists of the method of obtaining, in an electric translating device, actions or effects in direct proportion to the current flowing in another circuit or portion of the circuit, consisting in admitting current to said translating device in proportion to the square root of the current in such circuit.

401,882. Electric Belt. Charles H. Grimley, New York, N. Y.

401,927. Box for the Distribution of Electric Wires. David Brooks, jr., Philadelphia, Pa.

401,936. Electric Conductor. Thomas Egleston, New York, N. Y.

The first claim reads: "A wire or conductor having applied directly to its surface an insulating covering of fibrous material impregnated with a liquid fireproofing material consisting of a hydrated silicate of an alkali or alkaline earth and a binding material, the impregnated fibrous material forming of itself the insulating covering for the wire or conductor."

[illegible] Secondary Battery. William P. Kookogey, Brooklyn, N. Y.

The [illegible] plates are arranged in pairs with in[illegible] material between them, the positive plate be[illegible] of the plates are divided [illegible] sections being substantially isolated [illegible] the liquid is concerned.

[illegible] Electric Motor for Tramway Vehicles. William D. Sandwell, London, England.

402,006. Secondary Battery. Camille Desmazures, Paris, [illegible]

[illegible] combined with pure porous [illegible]

[illegible] accumulator, the combin[illegible] and pure porous metal [illegible] for [illegible] plates, [illegible] whole weight [illegible]

[illegible] Cable. Thomas [illegible]

[illegible] William Marshall, [illegible]

402,043. Annunciator Drop. John M. Stuart, Boston, Mass.

402,064. Switch for Electric Motor Trolleys. Will Christy, Akron, Ohio.

402,066. Dynamo Electric Machine. Carl Coerper, Ehrenfeld, near Cologne on-the Rhine, Prussia.

The invention is designed to reduce the heating and consequent loss of power to a minimum. This is accomplished by making the cores of the field magnet as well as of the armature of a series of thicknesses of sheet iron, which are placed side by side and united by suitable devices, said pieces of sheet metal having notches to receive the wires.

The third claim is appended. "In a dynamo electric machine, the combination, with an armature core provided with notches, of insulating pieces in said notches, tongues at the open ends of said notches, and cross pieces for retaining the wires in place in the insulating pieces."

402,080. Electric Car. John W. Henderson, Philadelphia, Pa.

The first and last claims are given: "1. In an electrically-propelled vehicle, the combination of two axles, an axle frame journaled upon each axle, a motor-supporting frame hung from said axle frames with provision for lateral movement, and an electric motor supported by said motor-supporting frame.

"23. The combination of two axles, a worm wheel on each axle, a worm for each worm wheel, a frame for holding the worm to the worm wheel, a detachable motor frame connecting the frames for the worms to hold them in place, a motor secured to the motor frame and movable with it, and a detachable connection between the motor shaft and worms."

402,084. Incline Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

The object of the invention may be stated to be the provision of an electric railway having line conductors with an electrically-propelled dummy or hill motor car, whose duty it is to assist the passenger car up the grade. Broadly considered, the invention contemplates the employment of an electrically-propelled dummy or motor car in a railway having a grade to assist the passenger car (also preferably electrically propelled) up the grade, when provision is made to allow the passenger car to pass the dummy or motor car.

Claims 9 and 17 are: "9. The combination, in a railway, of a main track having a grade, an auxiliary track at the grade, a passenger car adapted to run on the main track, an electrically-propelled dummy car to run upon the auxiliary track, a coupling between the passenger car and dummy, and a source of electric supply to the motor on the dummy.

"17. The combination of a main track having a line conductor, a parallel auxiliary track having a longitudinal conductor, a source of electric supply for said conductors, and a regulator to control the current passing to the conductor of the auxiliary track."

402,099. Printing Telegraph System. Claude J. A. Munier, Paris, France.

The invention relates to a new system for telegraphing by printing instruments—such, for example, as that of Hughes—and the new appliances used therein. It enables several printers to be operated over the same wire.

The sixteenth claim is given: "The combination of the polarized relays connected in pairs of opposite polarity, the electro magnetic multiple circuit controllers having polarized magnets connected in pairs of opposite polarity, the branches connected with the circuit changers of the relays, and the sub-branches connected with the branches and the circuit changers of the multiple circuit controllers."

402,104. Galvanic Battery. Robert J. Pratt, Greenbush Heights, N. Y.

402,107. Process of Welding Together Sections of Pipe by Electricity. Elias E. Ries, Baltimore, Md.

The process consists in backing the interior of the sections about the contiguous ends by means of an unyielding core, and then raising the said ends to a welding heat by means of a current of electricity, and upsetting the plastic metal to complete the weld.

402,108. Process of Welding Together Sections of Pipe by Electricity. Elias E. Ries, Baltimore, Md.

The process consists in heating the contiguous ends of the sections of pipe to a welding heat by the action of an electric current in the presence of a fluid pressure within the said sections.

402,117. Universal Upward Pressure Contact Arm. Charles J. Van Depoele, Lynn, Mass.

Claims 1 and 16 are given. "1. In electric railways, the combination, with the suspended supply conductor and a moving vehicle, of a contact-carrying device suitably supported upon the vehicle and comprising extensible members pivotally connected at their upper ends and provided with a contact device.

"16. In the described contact making device, having upper and lower members, the spring connection for said lower members consisting of a plurality of parallel springs attached at opposite ends to pieces pivotally connected to the lower members."

402,120. Message and Time Recorder. John C. Wilson, Boston, Mass.

402,121. Telephone. Edward A. Woelk, Belleville, Ill.

The first claim follows: "In a telephone, the combination, with the diaphragm and the two separable contacts supported independently of each other, and each movable toward and from the other, of a movable stop for the first of said contacts with which it engages when the contacts are separated, and a stop for the other contact, limiting its movement."

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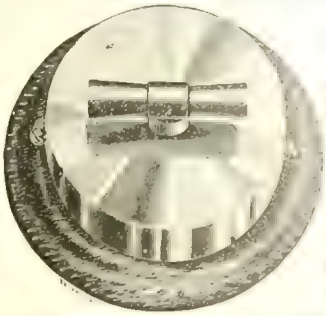

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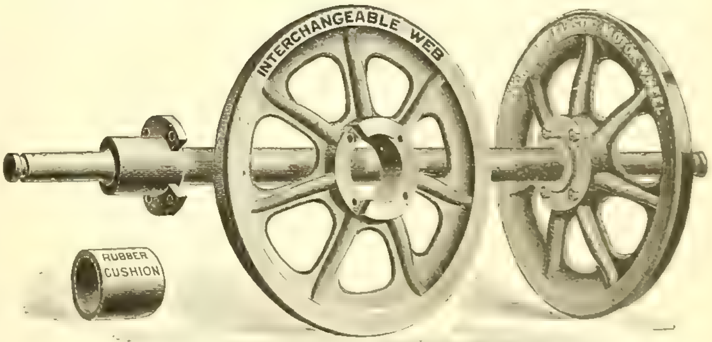

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West End Electric Railroad, Boston, Mass.
Port Huron Electric Co., Port Huron, Mich.
Chihuahua Railroad, Chihuahua, Mexico.
Bushwick Railroad, Brooklyn, N. Y.
Broadway Railroad, New York.
Third Avenue Railroad, "
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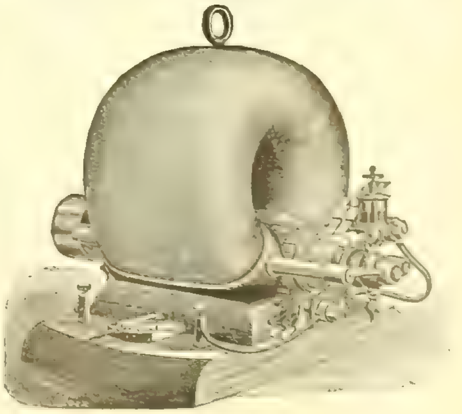

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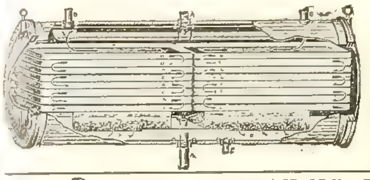

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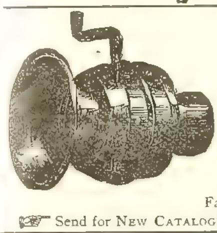

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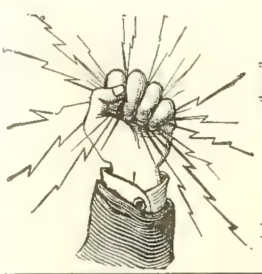

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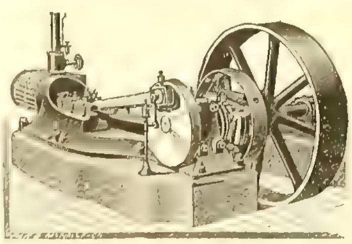

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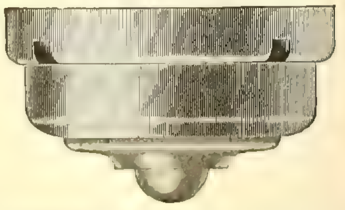

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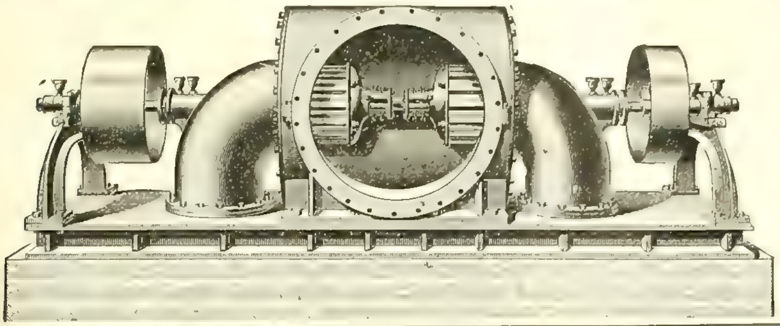

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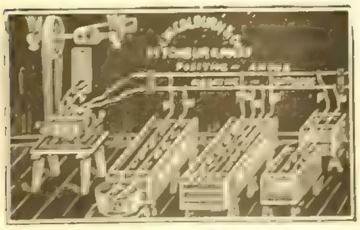

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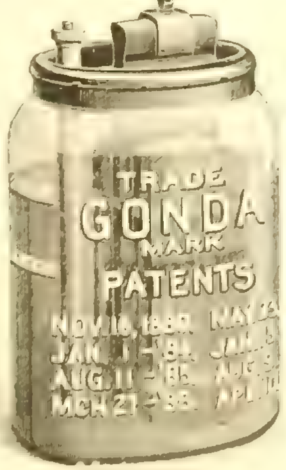

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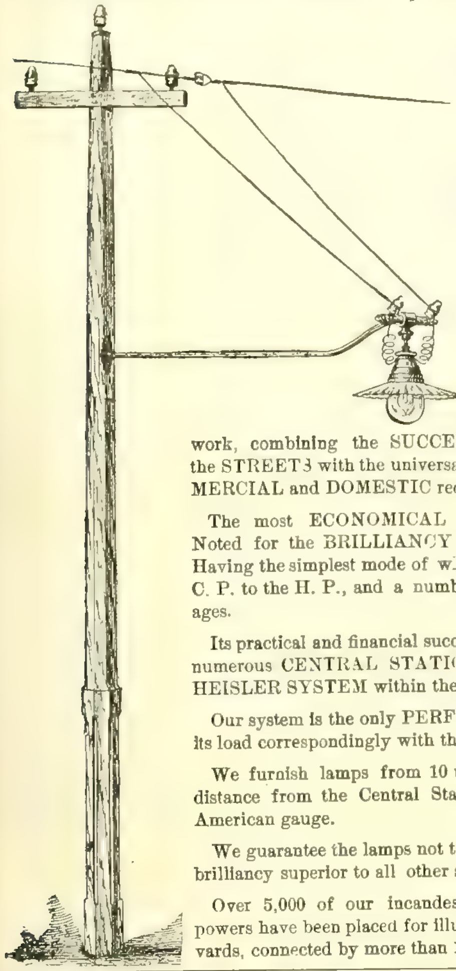

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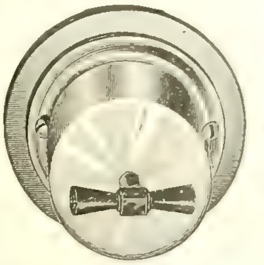

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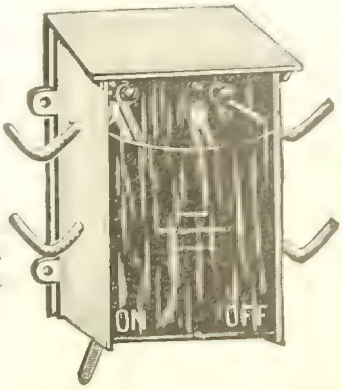

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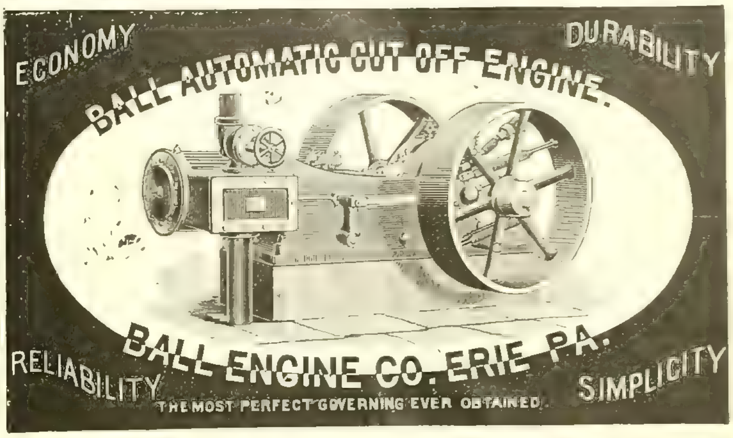

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Letters Patent Nos. 401,668 and 401,669,
Issued April 16, 1889, to
THE UNITED STATES ELECTRIC LIGHTING CO.,

Assignee of the original inventor, Edward Weston, of Newark, N. J.

The claims of these patents broadly cover the **core of an electric generator** subjected to inductive action, when composed of **alternate sections** of **magnetic** and of **insulating material,** in combination with the conductors wound thereupon.

This notice does not apply to the sellers or users of

DYNAMO-ELECTRIC GENERATORS OR ELECTRIC MOTORS,

which embody sectional armatures manufactured by THE EDISON ELECTRIC LIGHT COMPANY, our licensee under these patents.

All other parties are hereby warned against making, selling or using the invention covered by the above mentioned Letters Patent.

THE WESTINGHOUSE ELECTRIC COMPANY,

April 16, 1889. GEO. WESTINGHOUSE, JR., President.

WHO IS

The Pioneer in the Development of the Incandescent Electric Light System?

FACTS OF THE PRESENT CONTROVERSY.

THE NATIONAL ELECTRIC MANUF'G CO.

HOLDS THE KEY TO THE SITUATION

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"SUUM CUIQUE"

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Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simple a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

This company takes the position: First, to defend the users of its apparatus against loss accruing from its use; second, to vigorously and determinedly prosecute Walter K. Freeman's claims for patents covering these inventions.

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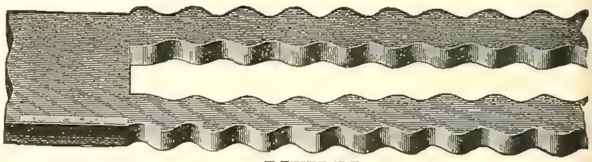

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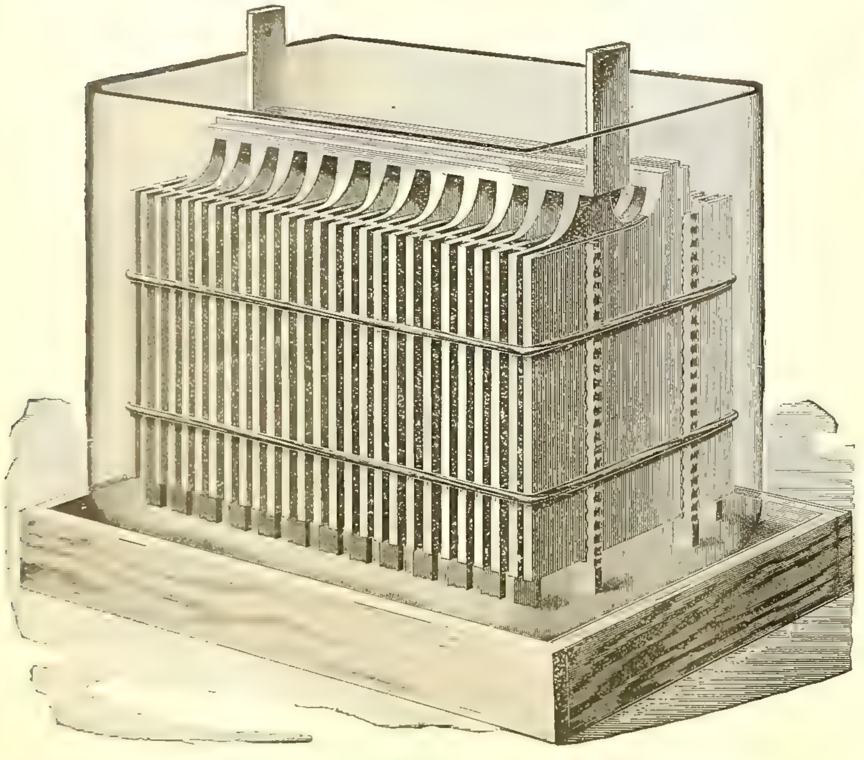

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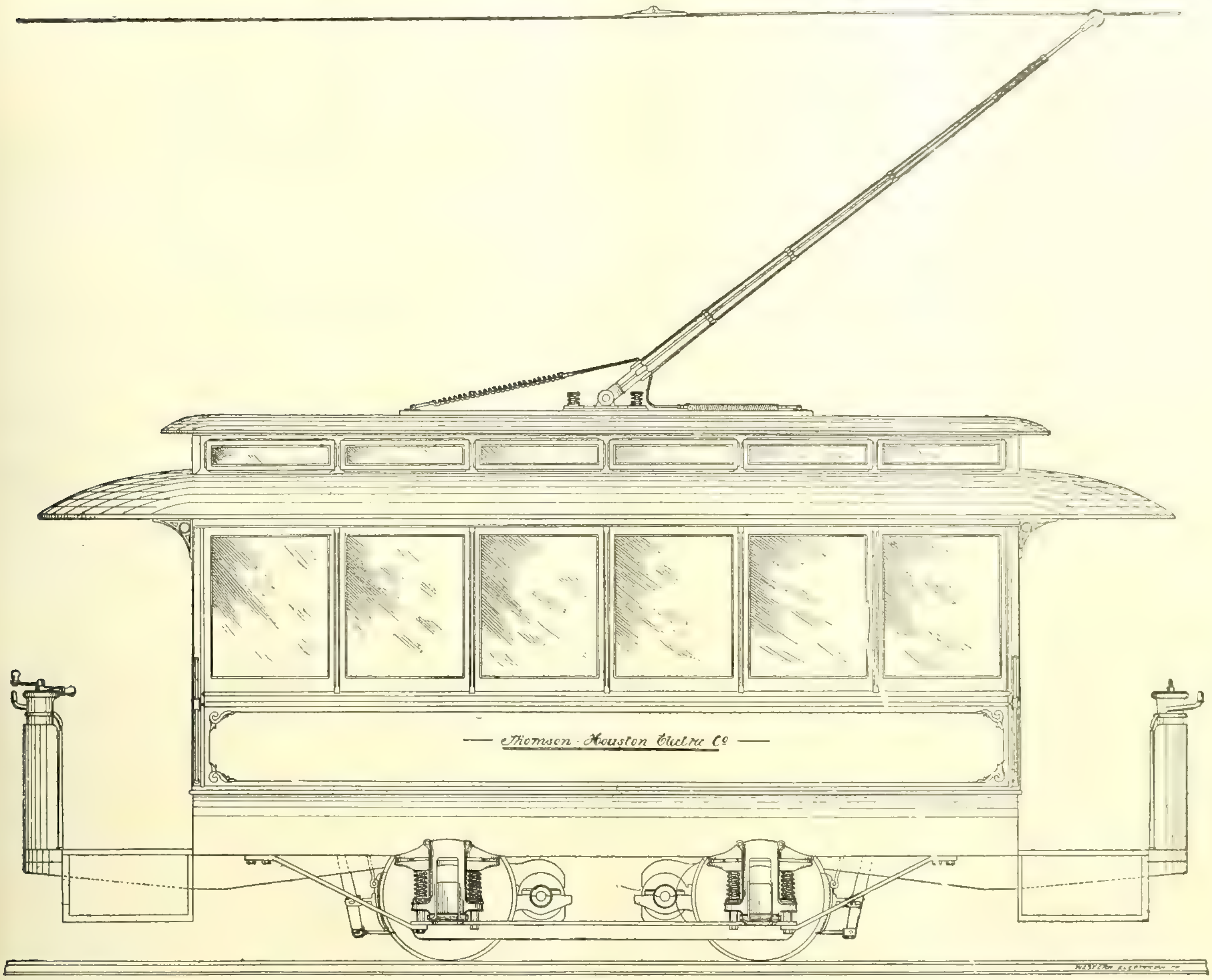

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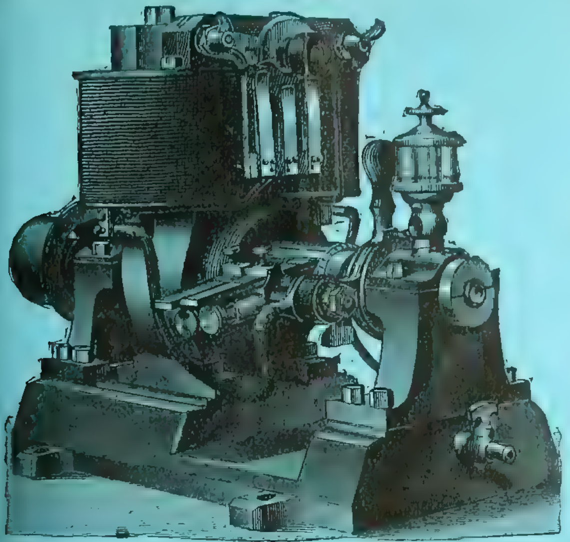

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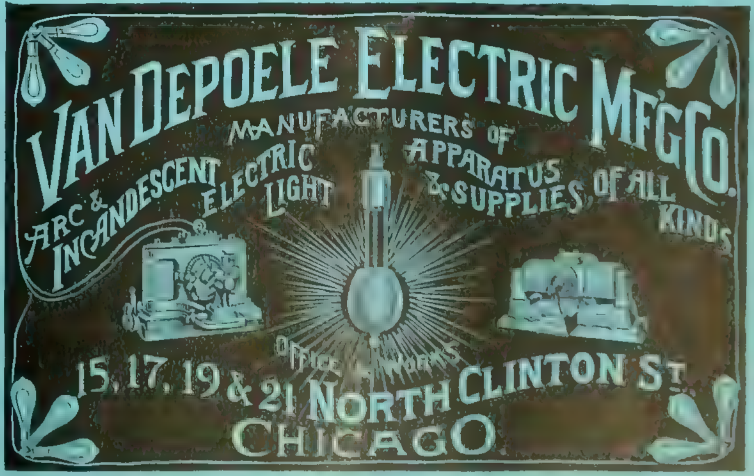

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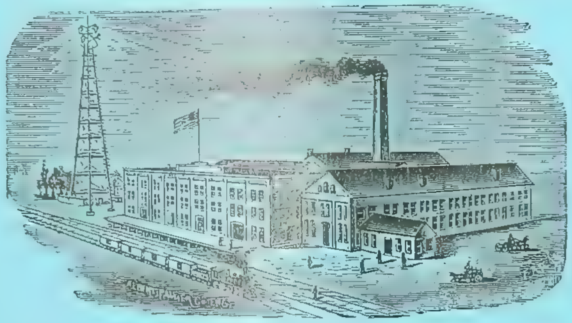

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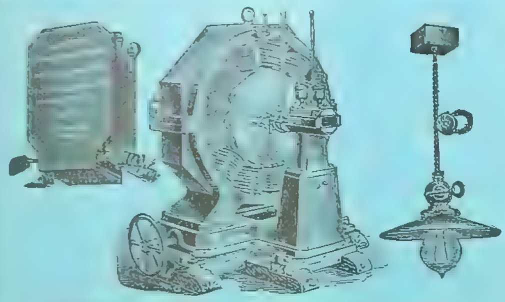

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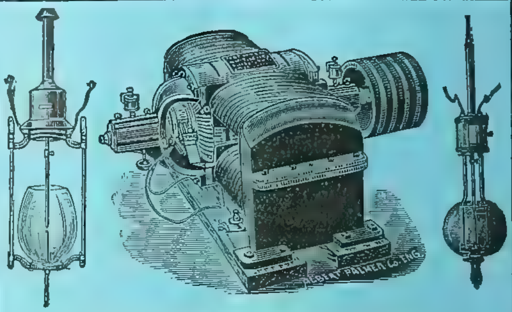

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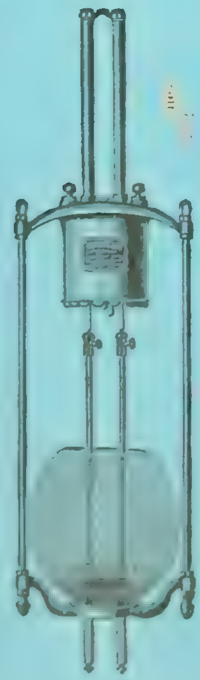

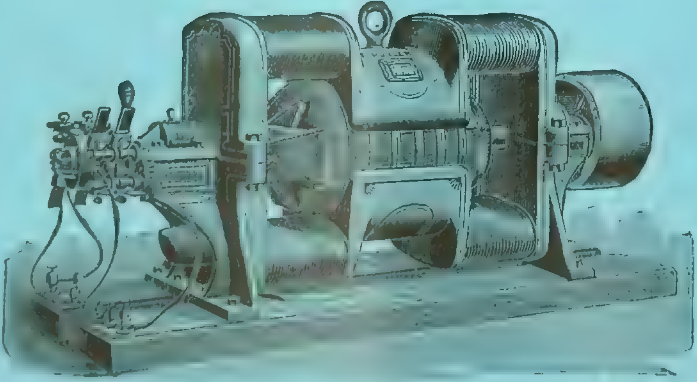

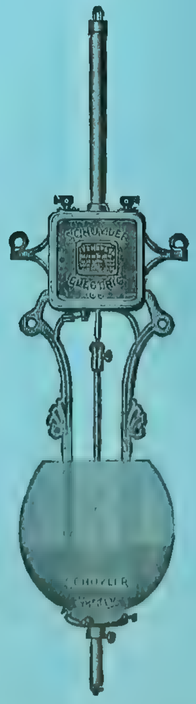

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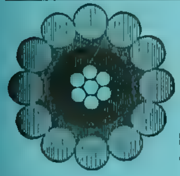

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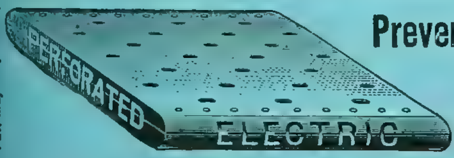

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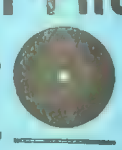
Buy no Bells  WITHOUT IT.

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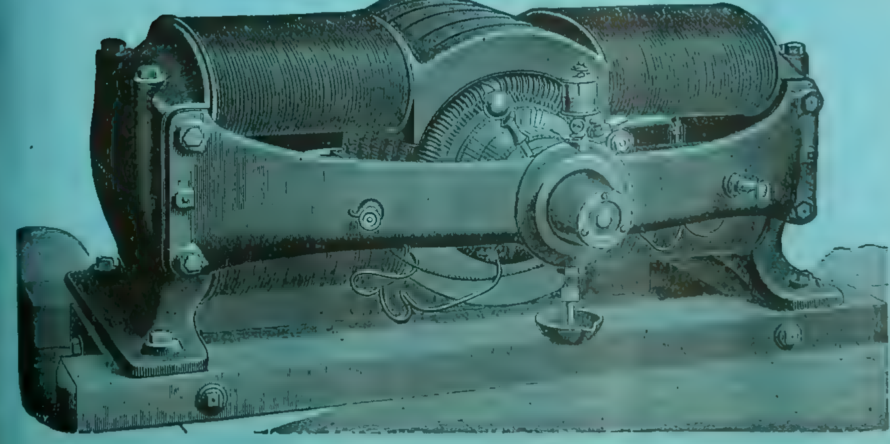

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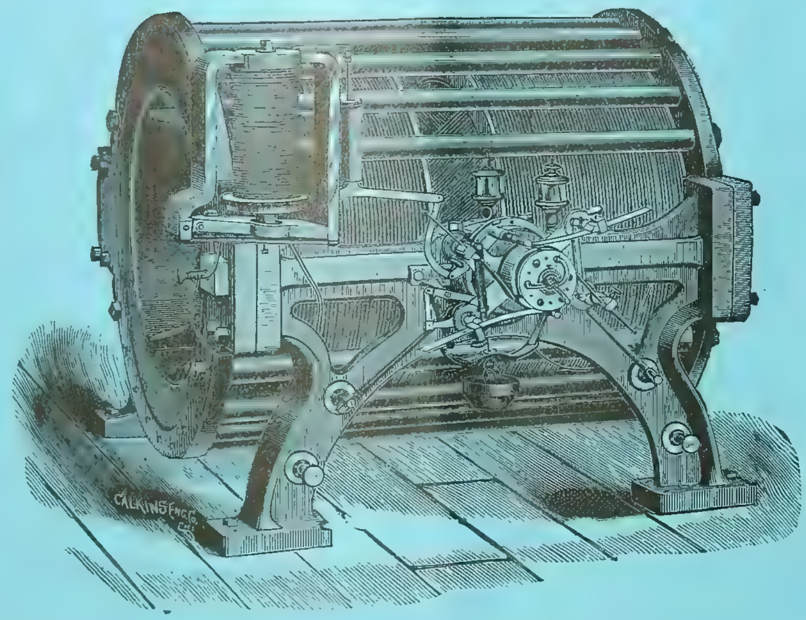

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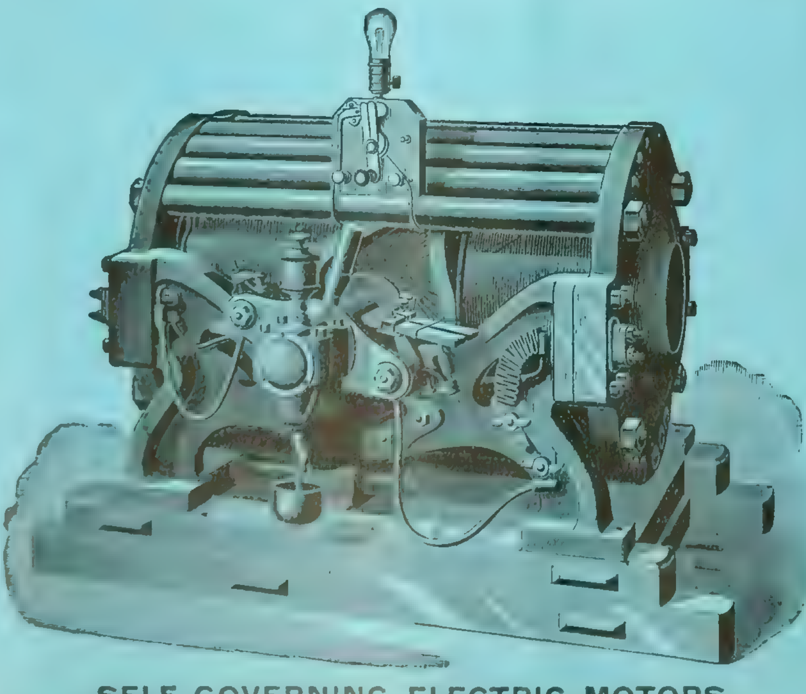

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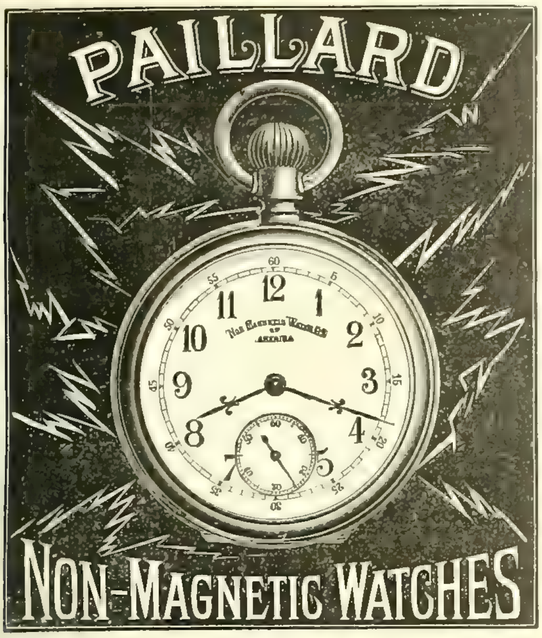

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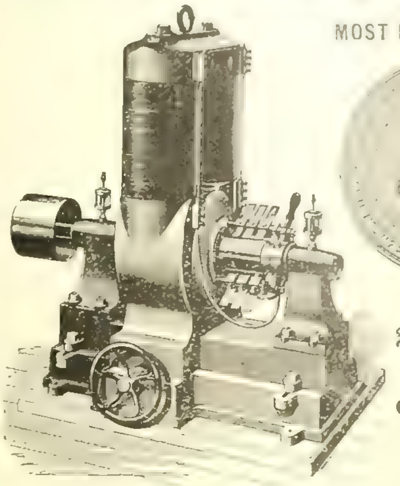

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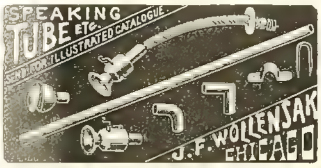

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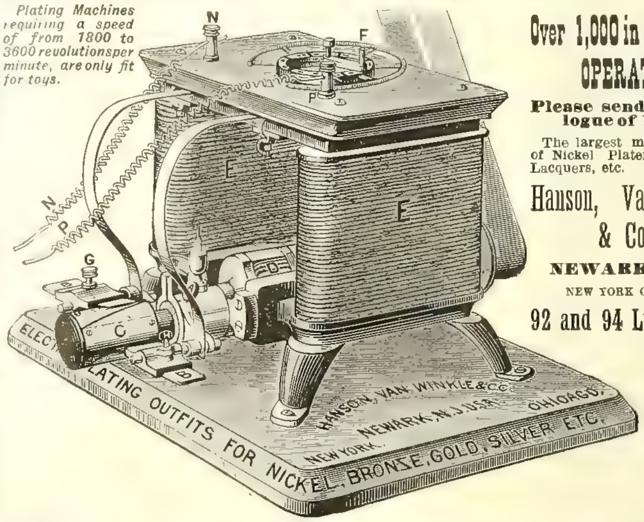

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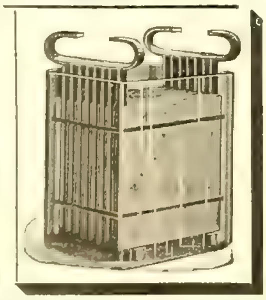

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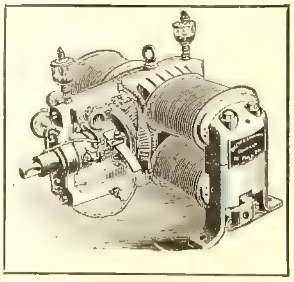

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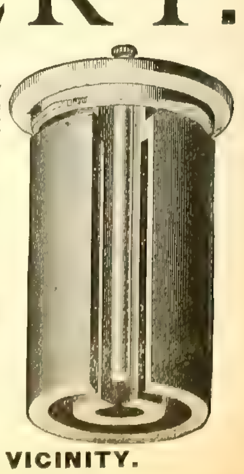

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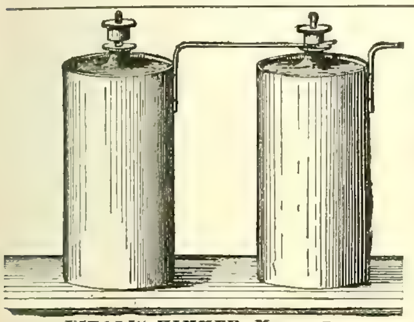

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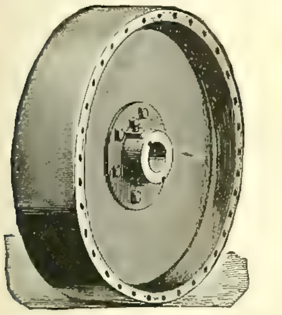

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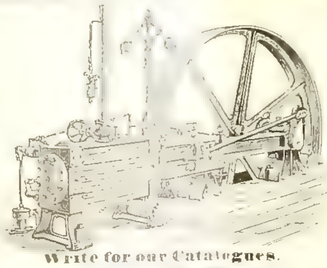

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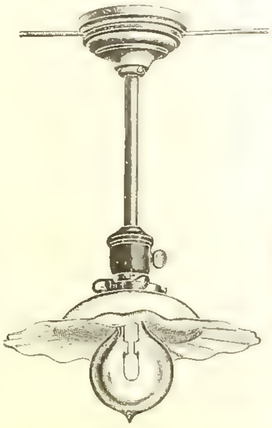

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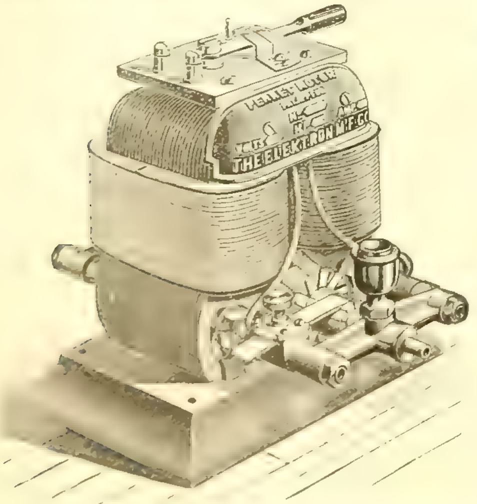

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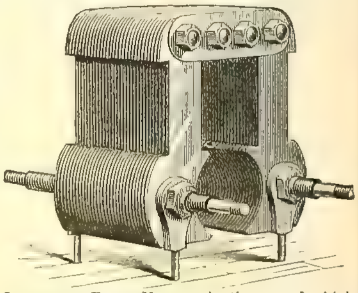

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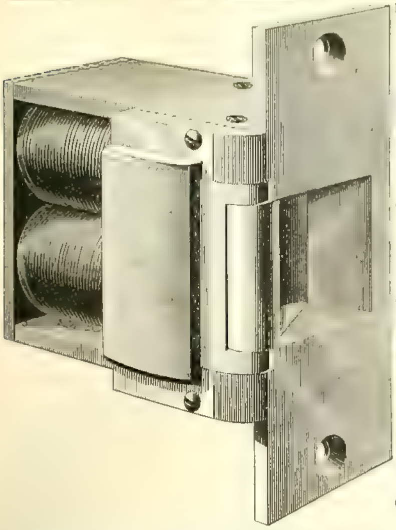

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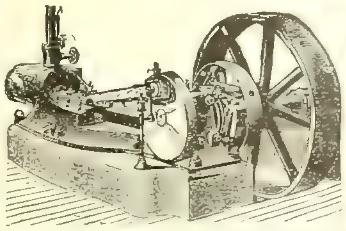

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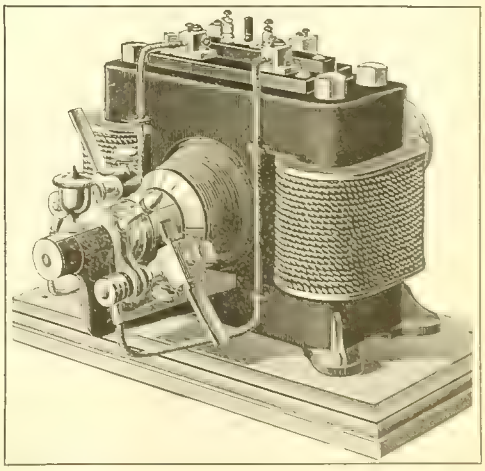

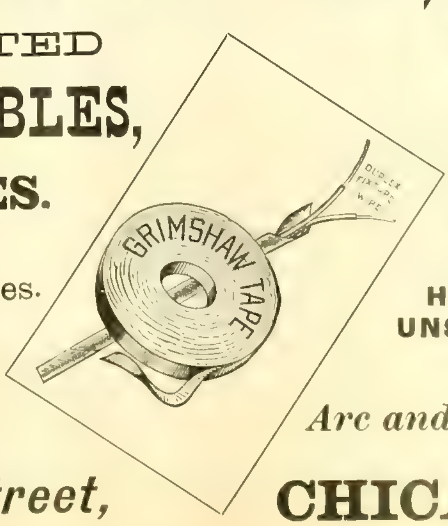

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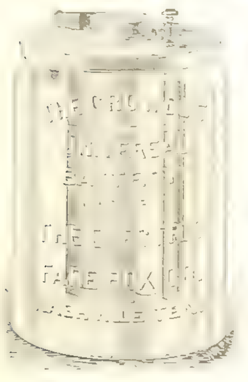

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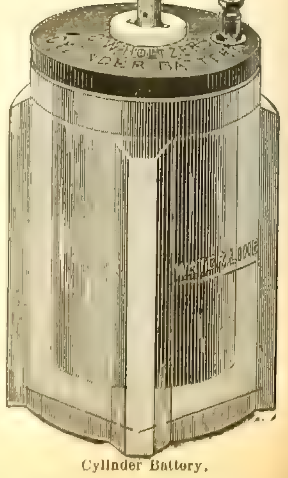

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SUSTAINING THE EDISON PATENTS

In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

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Vol. IV. CHICAGO, MAY 11, 1889. No. 19

John P. Barrett.

The prominence which Chicago has attained in electrical circles the world over is due in a large measure to its underground system of electric lighting which has been introduced through the efforts of its city electrician, John P. Barrett, whose portrait is herewith presented. Prof. Barrett is an earnest advocate of underground wires for large cities, and is proud of the success which has attended the operation of the Chicago system. He is a thoroughly practical man, and as he has demonstrated to his own satisfaction that electric wires can be operated in subways, he believes in underground conduits, and advocates the burying of wires in other large cities wherever his advice is sought. He is outspoken in his views, especially on all public matters, and independence has been a prominent feature in his character. This may be attributed to his experience in early life, a sketch of which will prove interesting. He was born in Auburn, N.Y., in 1837, but when seven years of age, removed with his parents to Chicago, which has since been his home. It was not his privilege to enjoy an extended education, though he was fond of books and made excellent use of his time at school. At the age of twelve years he went to sea, and from a ship's boy rose to the position of an able seaman. In a storm off the coast of Chili he met with an accident which, it was feared, would cost him his life. He was flung from a masthead, and crippled for life. Two other sailors who were with him were killed, but after nearly two years' suffering in a San Francisco hospital, Prof. Barrett regained his health, returning to his home in Chicago in 1865. It proved the turning point in his life. He was appointed fire watchman in the glass tower on the City Hall, which commanded a view of every housetop in the city, and it was his duty to sound the alarm at the first indication of a conflagration. This was his first public service, and the fire department of the city of Chicago has been greatly benefited by his connection with it. In fact, the whole world is indebted to him for developing the fire alarm telegraph system which is now in general use.

The accident which unfitted him from following his original occupation gave him an opportunity to prepare himself for his new field of labor. During his confinement at the San Francisco hospital he studied diligently and made remarkable improvement. He continued his studies while in the service of the city, and when his faithful performance of duty had won the confidence of his superiors he was prepared to perform the duties of a higher office, the promotion to which his intelligent service had entitled him. When the fire department was organized on the metropolitan system and telegraphy was employed as the means of communication between engine houses, Chief U. P. Harris, who had been attracted by Prof. Barrett's faithful work, appointed him battery man and assistant operator. Despite the objections of the fire commissioners to his appointment, because of Prof. Barrett's inability to operate, he was retained upon Harris' recommendation, and the latter's belief in his protege's ability to master the business. His confidence was not misplaced. Prof. Barrett studiously applied himself to the duties of his new position, and not only became an expert operator, but continued his studies and experiments, introduced new ideas, suggested many improvements, and soon became recognized as the authority of the office. In those days practical electricity was in its infancy, and Prof. Barrett succeeded in improving the service materially. When he was appointed chief of the electrical branch of the city service he was given a better opportunity to put his ideas into practice and conduct his experiments on a more extensive scale. The entire fire alarm service was remodeled, and the new chief's ideas introduced. The box system was first revised and much time was saved by the improvements introduced. For instance, a device which Prof. Barrett termed a "joker" was utilized, by which the alarms are

JOHN P. BARRETT.

received in the engine houses simultaneously with their arrival at the central station, the horses are released, and the firemen made aware that their services are required. With the growth of the city came new obstacles, but these were overcome as they presented themselves. It became necessary to employ a device by which only those companies whose services are required may be called out. For this purpose Prof. Barrett introduced his still switch which serves the purpose admirably.

But the fire alarm system did not employ all his attention. He devoted himself to the police patrol system, the underground telegraph system, the bridge telephone system, the scheme for lighting the river by electricity and numerous others. His ideas have been copied throughout the United States and Europe, and the electricians of the world make pilgrimages to Chicago to study the minutiæ of his department. He is still on the march onward and is now projecting a scheme by which all the bridges will be opened and closed by electric power from the main station [illegible] city hall. The [illegible] factory for the manufacture of all electrical supplies for the municipality is also receiving a large amount of his attention.

All of his numerous inventions and achi[illegible]ments, however, are insignificant in his own [illegible]mation in comparison with the system of electric lighting which he has introduced in Chi[illegible]. It was a great project and involved more than can be realized at a glance. For years the people had been clamoring for electric light. Chicago saw her sister cities brilliantly illuminated, while her streets were poorly lighted by gas and oil. To all the demands for electric light Prof. Barrett turned a deaf ear until he was satisfied he had solved the problem. Before introducing his system he caused the removal of poles and wires from the streets, and in this movement Chicago led the world. To-day its streets are no longer disfigured by unsightly poles and a network of wires, and no one in Chicago will question the statement that the city is improved in every respect by the change. The foundation for an extensive system of public lighting has been established. The plant will be enlarged each year until the entire city is lighted by electricity. The features of this system are familiar to readers of the WESTERN ELECTRICIAN.

There is no question that Chicago's example had much to do in bringing about the decisive action of Mayor Grant in ordering the burying of electrical wires in New York. Chicago set the example and other cities follow. Philadelphia, Boston and San Francisco and even smaller cities are now considering the subject. Electric companies generally do not look with favor on the present movement, and many prominent electricians say the time has not yet come for burying wires, but to all such Prof. Barrett says: "Results prove your fears groundless. You say electric light wires cannot be operated under ground. Come to Chicago and I will convince you that they can. If you really want to be convinced, if you are honest in your search for information, I will give you all the assistance in my power, and I think I can convince you that electric light wires can be operated under ground."

Telephone Bill in the Illinois Legislature.

Mayor Cregier and a number of [illegible] officers of Chicago visited Springfield May 2d in order to exert their influence in favor of the Eckhardt-Baker Telephone bill. Their efforts did not meet with success, however. The [illegible]hardt-Baker telephone bill was [illegible] house in the afternoon on the [illegible] bills on first reading, and after discuss[illegible] [illegible]ipated in by the leading members [illegible], it was referred to the committee on corporations. There is now every reason to believe [illegible] bill will either remain in committee [illegible] friends abandon it or that it will be radically amended. Senator Eckhardt, Mr. Baker, Mayor Cregier, and others were willing to fix the maximum rate for telephones in Ch[illegible] over [illegible] population at [illegible] per [illegible] bill was sent to second reading, wh[illegible] be so amended, but there was a [illegible] ity against them, and they fail[illegible]

[illegible] the house from [illegible] table. Even then [illegible] of four votes [illegible] the motion to [illegible] the bill to the committee on corporations, [illegible] as a substitute [illegible] committee, and in op[illegible]ng a reference of any character, Mr. Baker [illegible] the house. He [illegible] with deliberately attempting to strangle it by sending it to the committee on corporations, the chairman of [illegible] to it, and sooner [illegible] rather intrust the

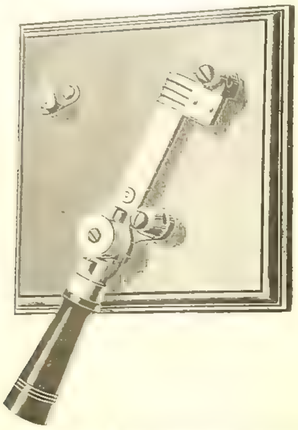


FIG. 1. ARC AND INCANDESCENT SWITCHES.

measure to the committee on judiciary. In replying to this Mr. Crafts cited the favorable [illegible] of the judiciary committee on a similar bill, and thought this one ought to go to another committee, the members of which would give a hearing to the telephone stockholders, who were ready to make a complete explanation of their receipts and expenditures. Mr. Allen of Vermillion, the chairman of the committee on corporations, stated that he had been petitioned by his constituents to oppose the passage of the bill. Notwithstanding this, he said he had as a member of the judiciary committee and through friendship for Mr. Baker, voted to send the bill out of that committee, so that the house might have an opportunity to discuss it. It was by his vote that a favorable report on the bill was ordered, and he considered it the basest ingratitude for Mr. Baker to accuse him at this stage of the proceedings of trying to kill it. Several other gentlemen spoke for and against the measure, and the previous question having been ordered and carried the roll was called, resulting in the reference of the bill by a vote of 69 to 67.

On May 3d the house voted to place the Eckhardt-Baker bill on the calendar for a first [illegible]

Chicago Electric Club.

[illegible] charge the [illegible] the Chica[illegible] they are making

[illegible]

Arc and Incandescent Switches.

Nothing marks the progress of electrical engineering so unmistakably as the demand for instruments, [illegible] supplies of improved construction, and involving principles which, though of recognized value, have not hitherto been adopted. The system of instantaneous movement switches shown in the accompanying cuts is put on the market by the Electrical Supply company of Chicago. The switches were designed to meet a growing demand for non-arcing switches. It is generally understood that a switch in which the movement of the arm is performed instantaneously has a great advantage over the ordinary switch, as arcing tends to burn and consequently destroy the contacts. The system shown in the accompanying illustrations fully meets every requirement of light central station incandescent work, and also every requirement of arc installations. These switches are substantially made of the best material; all wearing parts are of steel, and steel springs are used. The snap has a positive mechanical movement, and does not depend upon friction or upon passing of dead centers.

Fig. 1 illustrates a single point snap switch for arc or incandescent lighting. This switch has an opening of two inches, and the movement of the arm is instantaneous in both directions. It is mounted upon a finished black

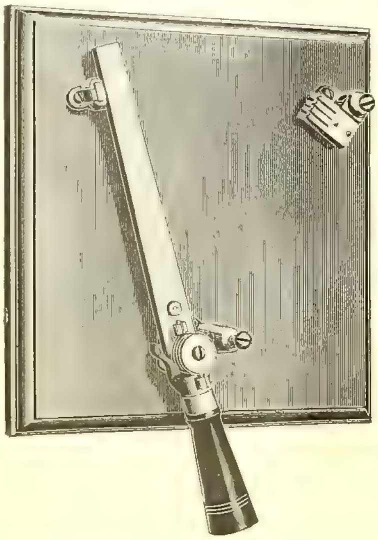


FIG. 3. ARC AND INCANDESCENT SWITCHES.

walnut base, stayed at both edges to prevent warping, and furnished with an ebonized handle. The metal parts are dipped and lacquered.

Fig. 2 represents a switch substantially the same as Fig. 1, with the exception that it is made double point, and is used for transferring circuit connection from one lead to another. The transfer in both directions is effected instantaneously. These switches are non-sparking.

Fig. 3 represents a switch similar to that shown in Fig. 1, with the exception that the parts have an extra long sweep of five inches. Mica is provided upon the base. The foregoing single pole switches are made in two sizes—first up to 15 amperes; second, from 15 to 30 amperes.

Fig. 4 represents a double-pole, single-point switch for use on incandescent or other service, in which both poles are severed simultaneously. The movement in both directions is instantaneous.

Fig. 5 illustrates a switch similar to that represented in Fig. 4, with the exception that it is made double pole and double point, and is [illegible] both poles of a line from [illegible]. The movement here is [illegible] instantaneously, and the switch is [illegible] non-sparking it should be [illegible] occurs at the switch [illegible] the current is trans[illegible] low resistance. The [illegible] made in two sizes [illegible] and the second [illegible]

[illegible] the franchise to erect [illegible] an electric railroad at [illegible]

The Copper Market.

So many conflicting statements have been made recently about the copper market and the recent conference of interested capitalists in Paris that it is difficult to ascertain just what the situation really is. In the first place came a report to the effect that negotiations had been suspended owing to a failure of the several interests represented to act in harmony, but this report was denied immediately by representatives of the New York and Boston daily papers, who investigated the rumor. Scarcely had these contradictory reports been received, and while copper men were still debating as to which was

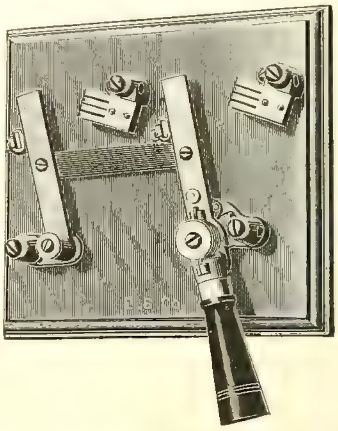


FIG. 4. ARC AND INCANDESCENT SWITCHES.

correct, when the Boston *Herald* published an extended cable reiterating the statements that the conference had failed to agree, and that the American representatives had left Paris in disgust, despairing of securing a settlement. But this, too, is denied, and a Paris paper says every detail was satisfactorily settled. It is probable that the truth of the matter will not be learned until the arrival of the American representatives.

The representative of the Boston *Herald* speaks as one in authority, and insists that his information is correct and authoritative. He says when the Americans reached Paris they found 175,000 tons of copper held as security for loans to the copper trust. The problem has been how to dispose of this copper and get back the money advanced, reimburse losses, and still keep up good prices. In view of the fact that American and English owned mines have large stocks ready for the market, to glut the market by unloading these 175,000 tons, and without in some way curtailing the output of the mines for a longer or shorter period, meant ruin to many and serious loss to all concerned, from employers in mines and metal industries up to the great financiers. Conferences were arranged between the American representatives and the Frenchmen. Day after day in the parlor these gentlemen met and discussed the situation. There was so much discussion the Americans grew weary. The Frenchmen talked and talked, talked and talked,

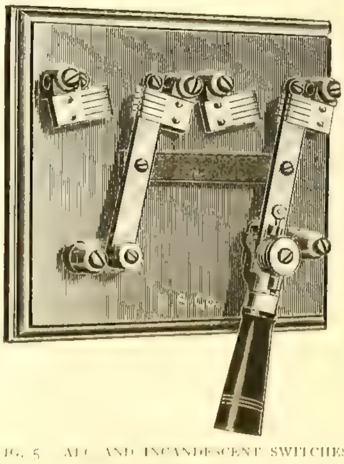


FIG. 5. ARC AND INCANDESCENT SWITCHES.

as Frenchmen will. They were profoundly courteous; it is their habit. They agreed something ought to be done, but did not agree how to do it. They expressed great surprise at the collapse of the copper syndicate and the fall of the copper market, and couldn't understand why

all their nicely laid plans went wrong. Then they adjourned for dejeuner, to meet again and go over the same old ground of argument and surprise; then they adjourned for refreshments. In the middle of the afternoon they returned to talk it all over again, and then adjourned for dinner, only to come back and repeat the previous performances. A fortnight went this way, the Americans clearly not disposed to assist in forming another copper syndicate, or to play into the hands of the European speculators. The Europeans were anxious to get rid of the copper on hand, but couldn't advantageously without the assistance of the American committee. These meetings began to grow monotonous, and J. B. Haggin, who was present, astonished the Parisians by gently informing them that they had talked enough, and if they meant business it was time for them to come to a settlement. Unless they did so he determined to return to America and put his copper on the market. It was evident that Mr. Haggin meant every word he said, and this impressed the Frenchmen. An agreement was finally made, but at the last moment Manager Doetsch of the Rio Tinto mine of London refused to sign, and after numerous delays the Americans sailed for home. This is the story of the Boston *Herald* correspondent, and he speaks with the assurance of one who possesses facts. The report is a source of much speculation among persons interested in the copper market in this country, and the arrival of the American representatives will be awaited with no little impatience.

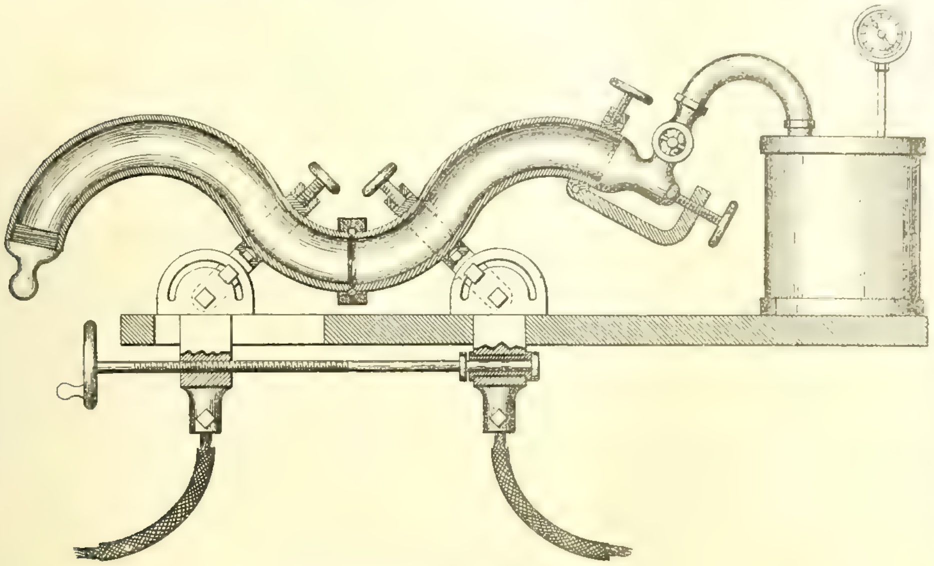
The Phonograph Ready for the Market.

Frank Z. McGuire of the Illinois and Indiana Phonograph company of Chicago has been in New York during the last week completing arrangements for putting the phonograph on the market in the west immediately. It was anticipated that the phonograph would be introduced last fall, but the delay was occasioned by the anxiety of Mr. Edison to complete a number of valuable improvements, and give them ample test. He has done so, and has found the new improvements satisfactory. Accordingly, arrangements have been made at the factories to get the orders now on hand filled at the earliest possible moment, and a large force of men is working incessantly in order to accomplish this. It is proposed that the phonograph will be placed on the market in Chicago and throughout the west at an early day.

Marcel Deprez has recently patented some new types of resistances and switches for use with high tension currents, such as for the transmission of force. In these he uses pure water as the connection, and the metals themselves never touching, there is no spark on breaking contact. Pure water is preferred for high tension currents, acidulated or salt water is only used for low tension and large quantity. The contacts can be made of ordinary iron or lead.

Electric Welding of Sections of Pipe.

Among the patents issued last week [illegible] granted to Elias E. Ries, of [illegible] welding together sections of pipe [illegible] low metallic articles by electricity. The [illegible] of pipe to be welded, according to [illegible] patents, preferably, though not necessarily, [illegible] the ends [illegible] to be united slightly [illegible] reduced in thickness, in order to [illegible] electrical resistance at this point and [illegible] the fusion of the metals under the [illegible] action of the current. A removable [illegible] fractory insulating material is inserted into the pipe at the commencement of the process, so as to fill the space immediately below and for a



ELECTRIC WELDING OF SECTIONS OF PIPE.

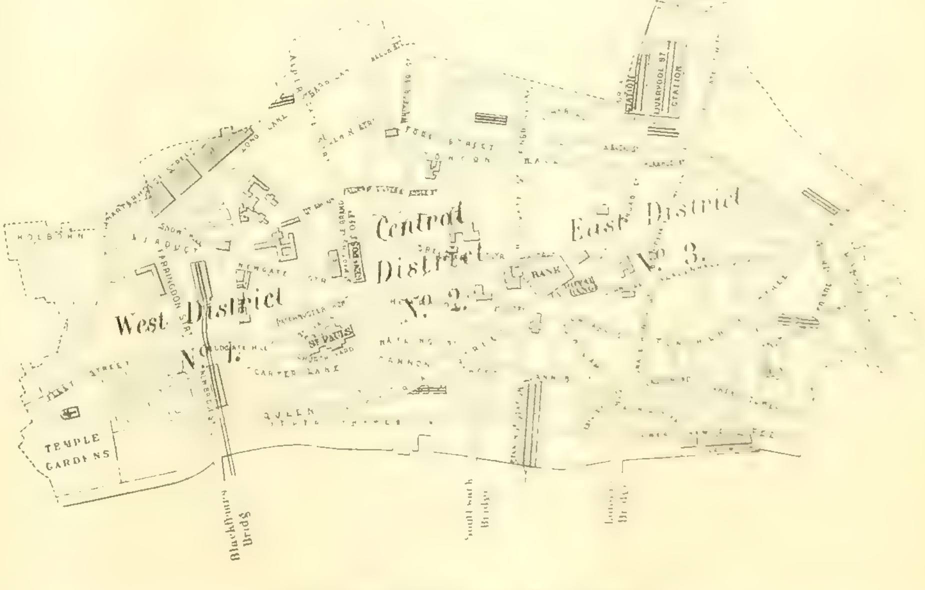
short distance on either side of the joint to be formed, so that when the sections are forced together as the metal fuses the upset or softened metal will be forced to the exterior of the pipe, thus leaving the interior of the welded pipe or other article perfectly smooth and free from obstruction.

This process is applicable to the electric welding of tubes and pipes of all kinds, and is especially adapted to the construction and laying of pipe lines, in which case a special form of expansible core is used. Joints formed in this manner are not only much stronger than ordinary pipe joints, but they have the advantage of being absolutely proof against leakage, and permit the construction of a line of pipe the interior of which is perfectly smooth and unbroken throughout its entire length.

In the second patent Mr. Ries employs an internal gas or fluid pressure to prevent the formation of an interior burr or projection during the electric welding operation. The abutting ends [illegible] [illegible] rrent until [illegible] [illegible] plicable to the welding of [illegible] [illegible] telegraph poles, refrigerating [illegible] [illegible] It will be obvious [illegible] principle can be utilized for the purpose of extending sections of pipe and other hollow articles heated by the electric [illegible] that Mr. Ries has other important applicat[illegible] pending on various modifications [illegible] as applied to the working and shaping of m[illegible] by electricity.

Electric Lighting of the City of London.

The authorities of London have finally waked up to the necessity of lighting the [illegible] tricity, and specifications for the work have been issued. The district which it is proposed to light is shown in the accompanying map, which is reproduced from the London *Electrical E[illegible]neer*. An English paper gives the following facts: The mains, which must be laid underground, whether for public or private supply, may be removed at the option of the commission, if it is thought that they are dangerous to public safety. The contractors will certainly have no easy time of it; they have to prepare ordnance maps, in which must not only clearly



ELECTRIC LIGHTING [illegible]

be shown the proposed positions of the [illegible] lamps, but also those of the existing [illegible] they must enter into [illegible] of the lamps, and also [illegible] the relative [illegible] gas, the [illegible] are to be distinctly shown [illegible] always [illegible] [illegible] manner deemed desirable; and, with a multiplicity of other items, those who tender will

[illegible] The [illegible] of twenty-one years is given as the term for public lighting allowed to the contractor, after which time he may be granted further license, or the commission may exercise its right to purchase. He is, however, allowed to continue the supply of electricity for private purposes, provided the contract has not been determined for other reasons, such as inefficiency, etc.

Electric Light at the Paris Exhibition.

At a recent meeting of the International Society of Electricians at Paris M. Hippolyte Fontaine read a paper on "Electric Light at the Paris Exhibition." The following facts are taken from the paper, and the accompanying cuts are reproduced from *Industries* of London: There are, in round numbers, 50,000 exhibitors, of whom each will spend on an average $600, representing an additional outlay of $30,000,000, so that the whole cost of the exhibition may be roughly estimated at $40,000,000. The total earning capacity of exhibitions depends, among other things, upon the number of hours during which the public has access. If no artificial lighting were used the total number of hours would amount to 1,620; but by the adoption of the electric light this number has been increased to 2,520, reducing the cost of the exhibition per hour from nearly $25,000 to a little over $15,000. Although this is a substantial gain wholly due to electric lighting, the administration has not cared to erect the necessary plant at its own cost, or to pay for the light at a fixed rate, as it does with steam, water, gas, etc.; but it has agreed to hand over to the purveyor of the light one-half the entrance money received from visitors in the evening, and which is fixed at 2 francs on week days and 1 franc on Sundays. The electric lighting plant has been provided and will be worked by the Electric Lighting syndicate, which has been formed with a view to make the lighting an international undertaking. The lighting has been divided between a number of firms and systems, and this will afford an excellent opportunity for comparisons. The machinery hall, which has a floor space of about [illegible] of 2,000,000 cubic [illegible] lamps of various [illegible]gest lamps are those arranged in four groups of twelve lamps close under the [illegible] These will be 60-ampere lamps, and will burn 25mm. carbons. They are [illegible] dots clustered together. The other black dots, which are [illegible] lamps. Of these eighty-six are 25-ampere lamps distributed in five longitudinal rows, and suspended [illegible] galleries [illegible]hinery hall and the stands adjacent to [illegible] lamps [illegible]

[illegible] which ten will be [illegible] power, eight of 200-candle power, and the remainder [illegible] will be

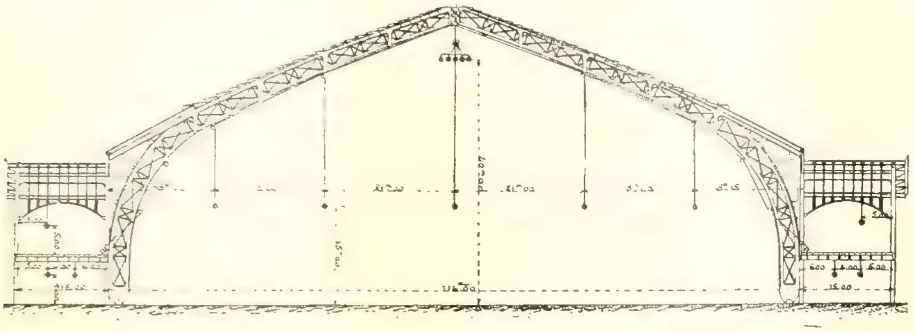


FIG. 1. ELECTRIC LIGHT AT THE PARIS EXPOSITION.

lighted by forty-eight arc lamps, requiring about 250-horse power. There will, however, be a second fountain lighted by eighteen 60-ampere arc lamps. M. Fontaine estimates that the aggregate candle power will be about $1\frac{3}{4}$ millions.

Underground Wires.

The work of cutting down the poles in New York city by order of Mayor Grant was continued last week, although interrupted temporarily by a wind storm, and again by the Centennial celebration. The main portion of the business center of the city has been cleared, and the choppers will hereafter devote their attention to other districts in which preparations for receiving the wires in the conduits have been made. The course of the mayor in this matter is generally commended, though there are some who persist that it was hasty. A New York correspondent of a Boston paper presents the following interview, which is given for what it is worth:

"The other day I called on Professor Morton, the president of the Stevens Institute in Hoboken, who has recently been asked to contribute an article to the series of electrical papers in *Scribner's Magazine*. He tells me that the conduits already put down are damp, badly constructed, and already half full of water. It has never yet been shown that the electric light wires for the arc light can be conveyed in conduits of any kind. Edison's can be, but they are incandescent lights only, and convey a very slight amount of electric power. The example of Chicago is quoted, and Professor Morton gives me the secret of the singular success with 'buried' wire in that city. There, after the great fire, most of the streets were raised nine feet, walls [illegible] each side of the road [illegible] the spaces thus formed the wires [illegible] electric wires [illegible] In Berlin, two or [illegible] through con[illegible] thousand dollars [illegible]

[illegible] of Chicago, says: [illegible] the secret of the [illegible] needless to say the [illegible] in the imagination of Prof. Morton, or the correspondent. The writer of the article quoted above, after attempting to show that underground wires cannot be operated, says:

"A company was soon found that rejoiced in the present state of affairs. They admit that many of the wires now in use cannot work in damp or narrow conduits, but they assert that they can provide a seamless rubber coating that is forced on under the pressure of ten tons to the square inch and then vulcanized, covered with a secret compound, and finally with a leaden tube, three-hundredths of an inch thick. This system has been adopted by the Manhattan Electric Light company, and a contract is being made with the Police department."

The company referred to is one of the standard companies of the country that not only puts its cables underground, but also warrants them for a nnmber of years.

In Boston, Philadelphia, San Francisco and Salt Lake City the agitation for underground system continues. The Citizens' association of Boston is urging the creation of a Board of Electrical Control, to whom shall be given the general power and supervision over all overhead wires, and whose duty it shall be to see that dead wires are removed, overhead wires are properly arranged, straightened, grouped and so hung as to disfigure streets and endanger life and property as little as possible, and place wires underground as soon as that can be safely and properly done.

The war in Salt Lake City is not favorably received by the local press which very sensibly realizes that Salt Lake City is not as large as New York, and that it is not necessary to bury the wires there. In relation to a petition to the city council, the Salt Lake City *Herald* says:

It is common sense that the wires in New York city be buried. The streets are narrow, and all the space is required for the traffic; the wires are in the way of the firemen, the poles are unsightly, and the whole thing is a nuisance. Accidents are constantly occurring on account of the posts and wires, and since the inauguration of the system of electric lighting, many people and horses have been killed by coming in contact with the charged wires. In Salt Lake it would be very nearly ridiculous to demand the burial of the wires. We have one wire to perhaps a hundred in New York; our streets will average in width very nearly twice that of the streets of New York, and it is possible that traffic here is a hundredth part of that on the streets of the city named. The wires in Salt Lake are little, if any, hindrance, and if sightly poles are erected, the appearance is not objectionable. Furthermore, we are of the opinion that an order to put the wires underground would be followed by the withdrawal of the telephone, telegraph and electric light companies from the city, as the business of the place would not justify the expense involved by the change. The time may come when Salt Lake will find it necessary or expedient to require the removal of the overhead wires, but that time will not arrive in this generation, even if the city shall "boom" beyond the expectation of the most enthusiastic boomer of to-day. With 132 feet of street width, and so much ground that high buildings will never be the rule, there will be plenty of room for poles and wires. There is one thing, however, which the city can properly do, that would improve matters: It can require the poles to be placed in the center of the street, and compel the use of larger and longer poles than are seen in some parts of the town.

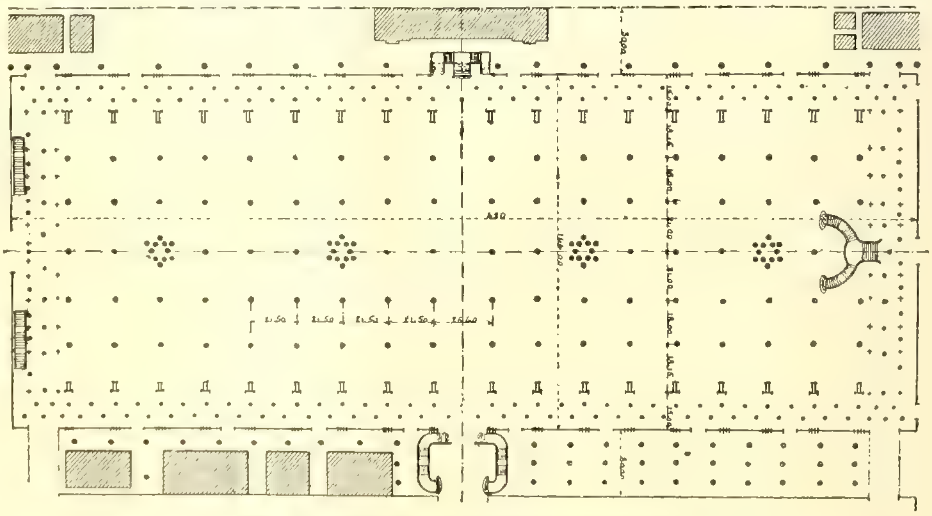


FIG. 2. ELECTRIC LIGHT AT THE PARIS EXPOSITION.

The bureau of navigation of the navy department is about to begin the preparation of plans and specifications for lighting by electricity the ships for which purpose the last Congress appropriated $55,000.

Peckham Elastic Motor Wheel.

The Peckham elastic motor wheel is shown in the accompanying cuts. It is peculiarly adapted for street car and electric motor work. It consists of four pieces in addition to the bolts by which it is held together. The central portion or hub, shown at the left of Fig. 1, is made of the best quality of steel castings, and is turned on the outside to receive the rubber that comes between it and the wheel proper or web. The latter is made of the best quality of selected charcoal iron, and is bored and faced accurately to templates so that all the parts are thoroughly interchangeable.

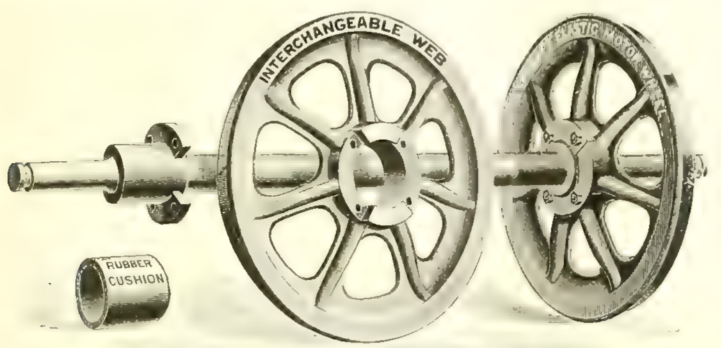


FIG. 1. PECKHAM ELASTIC MOTOR WHEEL.

In putting the wheel together the rubber is first placed in the web, and then the hub is put in and the whole securely bolted, a front plate, not shown in the engraving, serving to hold the rubber back in position. The wheel is pressed on the axle in the same way as the ordinary wheel.

Fig. 2 shows the wheel as used in connection with the Bentley-Knight truck. It is claimed that with this wheel the car rides more easily, that there is less ring to the wheels, and that there is less wear on the electric machinery attached to the axles.

The principal advantage claimed for the wheel is its interchangeability. With the ordinary equipment, when a wheel is worn out, all of the electric machinery must be removed from the axle, and the wheels sent to the maker to be taken off, and new ones substituted. With the Peckham wheel, however, it is merely necessary to roll the wheels from under the car, raise the axle, take out the bolts, pry off the web, slip in a new one in the place of that taken off, tighten the bolts, and the axle is ready for the car again. This work can be done by any unskilled laborer, and will occupy him for about one-half an hour per wheel. The wheel is manufactured by the Peckham Street Car Wheel & Axle company of New York city.

New Electric Railways.

The Sprague Electric Railway & Motor company has closed a contract during the past week with the Lindell Avenue Street Railway company, of St Louis, Mo. This contract calls for 10 cars of 30 horse power each, to be operated over five miles of track. The overhead system will be used. The line covers some of the principal streets of the city. The contract of this company with the Sprague company calls for a complete equipment including dynamos and full station outfit. The Sprague company has also made a contract with the Wilkesbarre and West Side Railroad, of Wilkesbarre, Pa. It will be remembered that the Wilkesbarre and Suburban railway was one of the first to equip with electricity, and since this road has been put into operation its success has been so great that its management has ordered an additional number of cars. The installation of this second line in the same town with the other lines is a most gratifying indication of the success which electric railways have gained. This line will extend over four miles of track and the equipment will include three complete Sprague cars. The Bay City Street Railway company has also contracted for electrical apparatus during the past week, and this equipment calls for eight cars and five miles of track.

In a recent communication to the common council of Brooklyn, Mayor Chapin discusses the question of public illumination, and presents facts to show that the city is now paying less than it did in 1875 for lighting its streets. In 1888 the estimated population of Brooklyn was 800,000, its tax levy for city purposes $8,284,330 25, and the cost of public lighting $180,000. In 1875, however, when the population was only 484,616 and the city tax levy $4,849,-208 66, the cost of lighting the streets was $575,000. In 1875 the city was illuminated by gas; in 1888 it was largely lighted by electricity. The appropriation for 1888 has not yet been exhausted.

Quartz as an Insulator.

A paper was recently read in England by C. V. Boys on the value of quartz as an insulator. Mr Boys found that quartz is under any circumstances a better insulator than glass, and that under the ordinary atmospheric conditions there was no comparison between them. This was very well shown in an experiment which Mr Boys made. A pair of gold leaves had been suspended by means of a hook formed out of a thick quartz fiber inside a case with glass ends, and had been electrified about five hours before the time of meeting. In order to make the conditions as unfavorable as possible, the air within the case was kept moist by placing a glass dish filled with water inside it, and the quartz hook was made very short. When the experiment was exhibited, the deflection of the gold leaves had only diminished by about one-fourth of its original amount. If glass had been used as a support for the leaves, the electrification would have been entirely dissipated in considerably less than a minute. As quartz, when once it has been melted, can be worked very much more easily than glass, it is said, this discovery of Mr. Boys ought to prove of great value in the construction of electrostatic instruments. Every electrician knows the annoyance

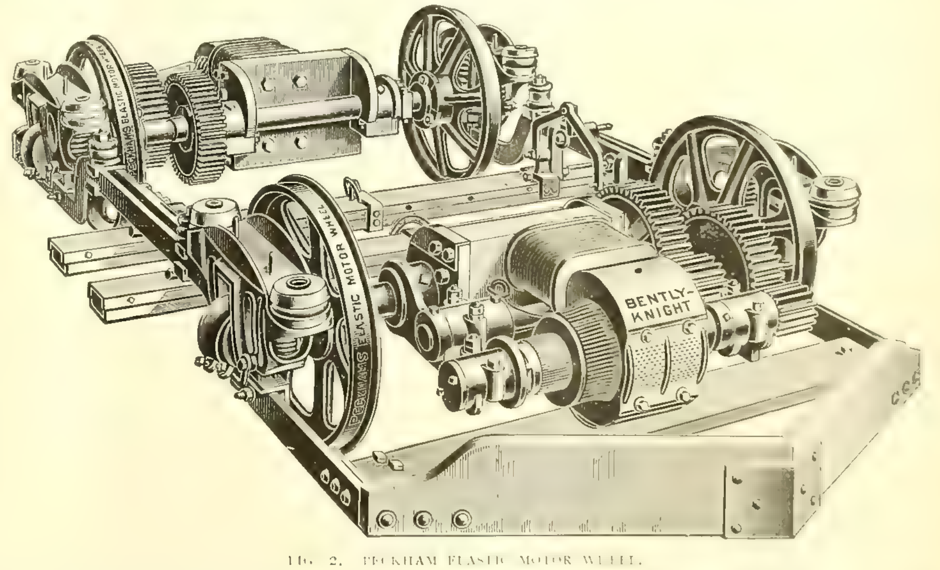


FIG. 2. PECKHAM ELASTIC MOTOR WHEEL.

caused by the necessity of employing sulphuric acid to dry the air surrounding the insulating supports, and this precaution need not be taken when quartz is used instead of glass. Mr. Boys stated that even if the quartz was dipped into ammonia, or boiled in a solution of potash, it only required washing with water to completely restore its insulating properties, and even when it was raised to a red heat these properties were recovered on cooling.

The electric lighting question at Jamestown, N. Y., seems now to be settled by the meeting of citizens last week. A contract is to be made with the Jamestown Electric Light & Power company for lamps for $6 per lamp per month. The bill now before the legislature, allowing the common council to bond the city to put in an electric light plant, will be allowed to become a law. The local company claims that at the rate of $6 if it can come out whole on the contract with the city, it will be satisfied.

[Elec]tricity as a Motive Power.

[illegible] that practically no repair shops were required, as no accidents happened, and [illegible] needed were a monkey wrench and a piece of sand paper. As for the objection to the appearance of the wires, he said one might cross the streets of Boston many times and never realize that there were wires overhead. Railway wires were the least objectionable wires [illegible]. Mr. Bracken of the Julien Electric Traction company spoke of the employment of storage batteries for street car work. He gave in simple terms an explanation of the construction of storage batteries, and then described at considerable length the Julien system on the Fourth avenue road in New York city.

Central Station at Milan, Italy.

Editor WESTERN ELECTRICIAN:

As you were kind enough to refer to the Milan central station in your issue of April 6th, it may be of interest to your numerous readers to be informed as to the present capacity of the plant.

We have now installed in this station 10 Jumbo Edison dynamos, each of 80,000 watts capacity (750 amperes, 110 volts); 2 Ganz & Co.'s alternate current dynamos, each of 80,000 watts capacity (40 amperes and 2,000 volts), and 8 Thomson-Houston arc dynamos, of a capacity of [illegible] candle power lamps each.

We are at present operating from this station [illegible] Edison lamps of various types, from [illegible] candle power, 200 Thomson-Houston [illegible] and 200 Siemens arc lamps of various types [illegible] amperes, and 10 electric motors, Sprague [illegible] of capacities varying from [illegible] to 10 horse power. [illegible] Siemens' arc lamps and the motors are [illegible] from the 110 volt incandescent lamp circuits.

We have in construction a new station for the [illegible] arc lights, with a capacity of 500 Thomson-H[ouston] [illegible] ampere lamps. All the main streets of M[ilan] [illegible] by arc lamps, and a large number of public [illegible] including the famous cathedral, Galleria, [illegible] Teatro La Scala, city hall, etc., etc. In all [illegible] are supplied with current from the Milan station. [illegible] them over a mile distant are lighted [illegible] converters. [illegible]

MILAN, ITALY, April 20, 1889.

The English electrical papers note the [illegible] underground railway company of London [illegible] gers are in the habit of stealing the [illegible]

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THE new Department of Electrical Engineering at Princeton is to be opened next fall.

A SOUTHERN railroad is maintaining an arc [illegible] When a wreck oc- [illegible] at any point on the road, the car is immediately dispatched to the spot.

[illegible] are already claiming prominence as electric railway centers. Cincinnati will [illegible] position. In the fall, it is stated, thirty miles of electric rail- [illegible] will be in operation in the city.

[illegible]

[illegible] for the streets [illegible] ented in [illegible]

[illegible]

Pennsylvania legislature will pass a law reduc- [illegible] for the use of [illegible] a year's trial [illegible] companies but all Hoosierdom cried aloud for its repeal. The people of Pennsylvania would never cease to [illegible] such a law to pass."

THE result of [illegible] of the American mine owners and [illegible] capitalists at Paris is anxiously awaited [illegible] interested in the copper market. The reports received from Paris are conflicting and contradictory in fact, and until the arrival of the Americans nothing can be said [illegible] appears a resume of the negotiations.

THERE has been some dispute in Pennsylvania whether electric light companies are manufacturing concerns or not. This is evidently not a mooted question in Texas. A San Antonio correspondent of a Galveston paper describes at considerable length a new artesian well in the former city, which furnishes enough power to run an electric light factory in addition to supplying the neighborhood with water."

THE Persian company, a corporation formed by eastern capitalists, intends to modernize Persia. It is stated that the company proposes to revolutionize the state of affairs in Persia by substituting modern railroads for camels, dromedaries and horses, electric lights for tallow candles, artesian wells for primitive ditches, and a national bank for the present financial system. Electric light privileges have already been granted by the Shah.

AN excellent portrait of Prof. J. P. Barrett, city electrician of Chicago, is presented in this issue. Prof. Barrett's great point of belief is the underground system, and his confidence in its efficiency and durability is bringing him into prominence, especially at the present time. The work of Mayor Grant's pole choppers in New York has caused many companies to experience a realizing sense of the fact that they, too, must soon cope with this question. Prof. Barrett is the man to whom many of the companies have already appealed for practical information on the subject. As he said at the convention, "If you are in a condition to receive information about underground conduits, I will be glad to offer it."

In the discussion on arc lamps which took place recently in the London Society of Arts, Mr. Mordey said that lamp manufacturers should keep before them the desirability of making one lamp which would do for every purpose. Many of the lamps described in Prof. Thomson's paper, excellent as they were, were only suitable for use under one set of conditions. He thought that a good arc lamp ought to be able to burn in series, in parallel, in multiple series, with constant current, with constant electromotive force, and with an alternating current, or a continuous one. Manufacturers should be able to make one lamp which would do all these things with only slight modifications in detail.

THE opposition of residents of the village of Niagara Falls to all proposals for utilizing the [illegible] waterfall provokes the [illegible] expression: "One [illegible] and of New York, too, for that matter, is the underground district, [illegible] of the goings [illegible] is disfigured. [illegible] plan of utilizing [illegible] machinery is [illegible] development is going [illegible] ng to indicate that there [illegible] waterfall [illegible] opposition to [illegible] t natural wonder [illegible] of Niagara [illegible] el of a dog- [illegible] tain citizens of that village to oppose anything and everything of a progressive character which they cannot control. They do nothing themselves, and they are not willing that others should. They do not seem to have aspirations above Indian gew gaws, etc." The question of utilizing the immense water power of Niagara is attracting considerable attention even in England, but it is not likely that any of the plans thus far proposed will meet with public approval. There is unquestionably a deep-seated prejudice throughout New York state, with the exception of a district of which Buffalo is the center, against employing the force now going to waste for any useful purpose. If the truth of this statement is questioned, an appeal to almost any New Yorker will establish its correctness. It will take a great deal of persuasive reasoning to convince the average resident of the Empire state that the location of machinery in the neighborhood of the falls would not in some way detract from the grandeur.

THE phonograph continues to excite the speculations of the fanciful and humorous. A recent writer is responsible for the following conceit: "Theatrical managers and playwrights are presumably on the alert, for the first phonograph that is effectively used in a drama will make a brilliant success. That will be the way to checkmate a villain! Let the instrument, of whose presence he was, of course, ignorant, repeat in his own voice the plot he has devised, and so afford unimpeachable evidence of his guilt and the hero's innocence. Perhaps, in an earlier act, owing to the machination of a ventriloquist, who is in league with the bad people, the voice of the hero will apparently be heard, so that what seems to be incontrovertible evidence will be forthcoming against him. Then, again, there is a chance for the extension of the singing master's profession. He can live in London and give lessons to a pupil in Devonshire, for the instrument will faithfully reproduce every inflection in the songs she sings into it, and she, if it be a she, can send the melody by post to her professor, who will tell her where she was wrong, and send it back again to her that she may the more distinctly understand his remarks. The critic, too, need not go to a concert. He can have the various performances phonographed, sit comfortably in his room, and write his notice at his ease as the items of the programme are reproduced."

NO PROGRESS was made last week by the advocates of telephone legislation in the Illinois legislature. Mayor Cregier and a pa ty of influential Chicagoans visited Springfield last week and labored with the representatives, but without success. The effort to advance the Eckhardt-Baker bill, which reduces telephone rates, was a signal failure. The following is an interview with Mayor Cregier, which shows the attitude of the new executive head of Chicago: "I have not yet given up hopes of the passage of the Eckhardt bill. It may require some amendment to allay some of the opposition. I am not one of those men, however, who think it is right to jump on every business enterprise having the name of corporation associated with it. Neither am I in favor of allowing monopolies to accept franchises from the people and leave the people without any rights. I do not favor the Ford bill, or any bill that gives power to city councils to regulate telephone charges. I think the Eckhardt bill fixing maximum rates would be much more satisfactory to the people, as it would take the question entirely out of the hands of the city councils. I believe the Eckhardt bill is a good bill, and with probably two or three small amendments would meet the wants of the people. I have been thinking over this matter, and have heard some discussion as to rates. There has been some talk of $8 a month being the proper maximum rate for Chicago, but I think about $80 a year would perhaps be more satisfactory to the people. I should favor such a change in the Eckhardt bill." Mayor Cregier is certainly more liberal than many of the municipal officers of Chicago, who proposed to cut telephone rates in a ridiculous fashion, making them about one-quarter of the present rate.

Berlin Central Station.

In Prof. George Forbes' paper on electric lighting stations in Europe is given a description of the Berlin central station. An abstract of the description which he gave of the station follows. The Berlin mains supply 30,000 lamps of 16 candle power, and 1,4[illegible] are lamps of 15 amperes. The conductors are all laid underground. There are three central stations at work, and two more of improved type are in process of construction. The foundation of the station on Margrafen Strasse are of concrete, in iron boxes built up with brickwork and cement. There are six engines of [illegible] horse power each, each driving Edison dynamos. There are also four engines of 400 horse power each, each driving a new type of dynamo direct at eighty revolutions per minute. These are compound tandem Corliss condensing engines. The attached dynamos are by Siemens and Halske. The Electric company of Berlin are also making a machine somewhat similar. The cut shows this dynamo and the engine combined, the height of which is twenty three feet. The continuous current dynamos are worthy of some notice. They may be described as multipolar Gramme machines, the poles being radial and the ring armature external to the poles.

There are ten poles on each machine. The armature is [illegible] metres in diameter, the commutator is $1\frac{1}{2}$ metres in diameter. There are ten brush holders. Each pair of poles and the corresponding part of the armature, with the corresponding pair of brush holders constitute a section which is virtually one machine. All these sections are joined in parallel. The field magnets are not seen in the drawing, being inside the armature. Two handles are provided, one of which adjusts all the brushes at the same time; the other puts them on altogether. Each brush holder carries four brushes. A similar dynamo is being made by the Berliner Elektricitats-Werke, in which the radial poles are external to the armature. I believe that this type of multipolar machine is a good design where the object is to get a large output with a slow speed.

At this station the boilers are fed automatically by means of a hydraulic accumulator. The water for condensing is drawn from fifteen artesian wells, which have been sunk for this purpose. Steam is used at a pressure of 115 pounds, and it is claimed that 15.5 pounds of steam only are required per electrical horse power. This is probably the most economical production of electricity for central station work in the world, and the engines and dynamos, though expensive, must certainly have a very low depreciation. The maximum work which this station can do is to generate a current for 26,000 lamps of 16-candle power. It is found that the maximum number of lamps in use at any one time is about 66 per cent. of the total number of lamps.

The thing which strikes one most in this station is the enormous mass of copper. The conductors inside this station consist of eight strips of copper six inches wide and one third of an inch thick. These are laid into the room for cable terminals. These strips, before entering this room, are interrupted by a gap, and a junction is made by punching seven similar strips, about eighteen inches long, between the strips and the interrupted ends, the seven strips being placed between. Thus, in case of any serious accident, the whole of the mains can by one turn of the screw be disconnected from the dynamos, the interlapping pieces all dropping out. The only exception is in the case of theaters, where, to prevent panic, a separate connection is made with the dynamos. In the cable terminal room the positive and negative mains run horizontally, and vertical rods come down to the different cables. There are eighty-four of these cables, forming forty-two pairs of feeders supplying the network of mains with current on the two wire system. These cables are generally of large size, being frequently three inches in diameter complete. They consist of stranded cables covered with jute prepared with bituminous compound, inclosed in lead, then covered with tape and presertative compound, and finally armor plated with two crossed spirals of iron ribbon. The system of feeders and mains is one of the features to which I wish to direct the special attention of English engineers, since the principle has been adopted of trying to produce as small a variation of pressure in the mains as possible. This is accomplished by having a large number of feeders. The cost of the underground cables has hitherto amounted to about £90,000, half of this being spent in mains and half in feeders. The greatest variation of pressure allowed in the mains is $1\frac{1}{2}$ per cent. The loss of pressure in the feeders during periods of maximum supply is fifteen volts.

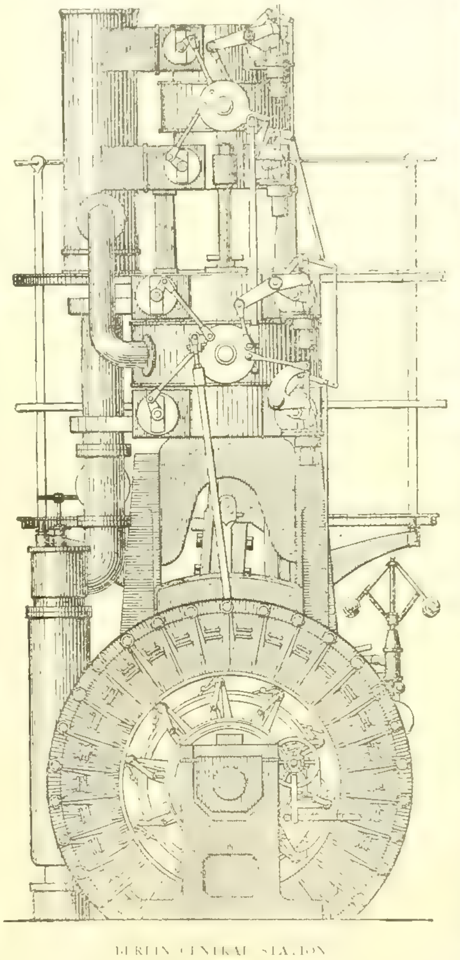
A man of high training, accustomed to the use of scientific instruments, is always in attendance and looking after the amperes and volts from the different machines and pilot wire, and recording the measurements. One of the most interesting parts of this central station is the switchboard, with the special means for introducing a fresh dynamo in parallel or cutting it out. This also is a point to which sufficient attention has not generally been given in England. In all foreign stations that I have ever seen, when a current of over 100 amperes is switched in or out, it is found necessary to make use of an auxiliary load in the form of resistance, a bank of lamps being generally employed as being the cheapest resistance available. When a new dynamo is going to be introduced in parallel it is first worked on an artificial load, and the exciting current regulated until the volts and amperes agree with those of the other dynamos with which it is to be put in parallel. As soon as this equilibrium is attained the mains are switched into connection with the new dynamo and its load. After that the load is taken off. This prevents the possibility of the dynamo thus introduced being caused to run as a motor in the wrong direction by the current from the other dynamos; and prevents too violent a sparking at its brushes. The switch-board at this central station for the four large dynamos with the accompanying artificial load or resistance, and with its ammeters and voltmeters, is very perfect. Facing the operator, the switch-board is in four sections for the four dynamos. Each dynamo has three massive double-pole switches: one for the dynamo, one for the artificial resistance, and one for the mains. Plugs are [illegible] for varying the [illegible] artificial [illegible] ammeter [illegible] for each [illegible] a voltmeter [illegible] one of [illegible].

Underground Conduits and Electrical Conductors.[1]

[illegible]

[illegible]

My [illegible] in bringing this subject before you [illegible] interchange of opinion [illegible] concerning [illegible] the few remaining [illegible] with the general [illegible] of [illegible]. Since I began to write this paper on my [illegible] much [illegible] has appeared in the [illegible] and the [illegible] America is [illegible] by a like spirit of inquiry here. The outcry against overhead wires has been [illegible] and although the numerous [illegible] solid grounds there is a general feeling that [illegible] able extension of overhead cables for electric lighting is impossible, both on account of the difficulty, and no inconsiderable expense, in procuring wayleaves, and also the attitude taken up by the Board of Trade and others to put a stop to them. Overhead wires in this country may therefore be simply considered as a temporary measure to admit of the electric supply companies getting to work, and permitted only on the distinct pledge of the removal of such wires within a certain period.



BERLIN CENTRAL STATION.

The time allowed for the execution of underground works in provisional orders and licences, although as long a period as could be obtained, is all too short, and a thorough discussion of the subject at the present time, in its numerous aspects, is highly advisable to enable it to be afterward promptly and adequately dealt with.

In three months we may reasonably conceive that certain electric supply companies will be under legal obligations to at once face the problem of putting high tension electric conductors underground. It will be no petty attempt narrowed down to a small area, but in two special instances the undertaking is proposed to be carried out on a large scale by companies of adequate financial resources, and with supply stations already erected, or in process of erection.

"Is failure probable?" may seem a singular question to put here, but it is a necessary one, leading up to the various difficulties to be encountered, and in view of the alarmist statements at the recent electrical convention in Chicago, one that deserves prominence. Mr. Lynch's paper, giving the results of the working of underground cables, and which was practically the only part of the meeting reported in the English papers, showed but one side of the case, and from the discussion following it much was to be learned. Many of the companies operating underground cables had for some cause or other not given their opinions, and the failures alluded to were in several instances traced to defective conduits, insufficiency of insu-

[illegible]

[illegible] first equal to all possible requirements otherwise any extension [illegible] would necessitate a repetition of the [illegible]. In this [illegible] cost of [illegible] nearly as great as the [illegible]. Finally, the life of the best cable for high tension currents cannot at present [illegible] undoubtedly [illegible] drawing in [illegible] system [illegible].

An [illegible] system of underground [illegible] well covered and ventilated, and [illegible] of a man working in it [illegible] what comes next best. In New York [illegible] has been placed in the hands of a Board of Electrical Control, they start out by saying that a [illegible] electrical conductors is nothing more than a mechanical protection for the wires within it, and a convenience for placing or putting them underground. In the [illegible] of three years the Board of Electrical Control have practically tried and abandoned many conduits. In [illegible] the telephone building, New York, occupied by the Subway Construction corporation, there is a heap of [illegible] experience gained at no little cost—that it would be of advantage for engineers who lightly propose [illegible] such work to see and meditate on. [illegible] bitumen conduits, asphalt conduits, earthenware conduits, samples of underground conductors all are [illegible] termed the museum and afford a collection [illegible] most instructive as to what not to do.

In many instances, however, the conditions there would not apply to England. At present we have [illegible] steam-heating with leaky pipes, causing trouble wherever they go. Again, here we have not those great [illegible] heat and cold, the frost compelling conduits to be laid at an average depth of 4 feet, and the heat causing [illegible] troubles with asphalt and bitumen conduits. [illegible] time from the numbers of miles of conduits laid down there should be something to learn, and I therefore propose instancing some of the more important [illegible] known in America and elsewhere.

Conduits are divided into two classes. The solid [illegible] conduit, and the hollow conduit. Solid conduits are useless considering here, as they practically consist of cables bedded in asphalt or bitumen, which means ripping up the ground, and breaking the inclosing mass if alterations are required. With hollow conduits, the [illegible] to be encountered seem to be to provide a smooth [illegible] convenience for drawing in and out to prevent explosions through accumulation of gas, and to keep them [illegible] dry and water-tight.

In the discussion at Chicago it was stated that [illegible] instance it was necessary to keep a blower [illegible] late an iron conduit, while several authorities [illegible] consider it advisable on dry days to take off the [illegible] covers. Accidents have, of course, occurred from conduit explosions, and the engineer of the United States [illegible] Lighting company instances one where the [illegible] of the conduit were blown over the roof of a four-storied building. But in England, again, the [illegible] gas companies is far better and the leakage [illegible] is not in any way to be compared with the [illegible] illuminating gas which wanders [illegible] of many cities in the United States.

It appears desirable that conduits should [illegible] and the form adopted, where possible [illegible] by means of a pipe running into the base of [illegible] of the street lamp posts. With regard to [illegible] water-tight, this is another [illegible] capable of being properly dealt with.

[illegible] conduits have [illegible] the States, and have been a [illegible]

[illegible]

[illegible] ing dampness unless [illegible] the conduit and [illegible]

[illegible] wever, with a view [illegible] protection to the [illegible] for instance, is well known here. It is being extensively laid down by the [illegible] Electric Lighting company, and 500 yards of it is [illegible] Supply company [illegible] ful, but, perhaps, discussion something may be said on this point.

Vitrified 3 inch sewer pipes laid in concrete with cement [illegible] for underground [illegible]

Pipes of glazed earthenware with several ducts form a [illegible] capable of resisting [illegible] the glazing both inside and outside provides also, under certain conditions, [illegible] desirable that [illegible] non-conductor, than [illegible] such glazed earthenware, [illegible] difficulty of maintain- [illegible] has been referred to [illegible] for telegraph [illegible] given by Mr. [illegible] trees, branches and other vegetation having made their way through these joints. Is [illegible] a flexible joint, which [illegible] at any rate prevent joints giving through expansion [illegible]

The great disadvantage, however, to the use of earthen- [illegible] many places in a city like London is the amount of space required for them; in fact, the difficulty of [illegible] at all in some of our streets will be [illegible]

As [illegible] protection only, it is immaterial whether the conduit be a non conductor or not. [illegible] of course, [illegible] and the Western Union Telegraph [illegible] streets, have laid cast iron pipes [illegible] inches diameter, with man [illegible] of about 450 feet apart. In the majority of cases, however, the plan has been to lay a number of separate iron pipes in a concrete bed, by which arrangement the pipes can be crowded, or curved, or kept apart, [illegible] best overcome any difficulties or obstacles met with underground. For instance, four pipes may be laid on the same level in two layers, or where only a narrow excavation [illegible] the pipes can be curved round so that [illegible] in four layers. In this way the trenching is often materially diminished. Screw jointed, [illegible] wrought iron pipes of two or three inches [illegible] laid in hydraulic cement concrete, are said to [illegible] tightness of duct against gas and water, together with the greatest strength.

Cement-lined sheet iron pipes, however, possess some advantages, such, for instance, as smooth interiors, and [illegible] without the cable be [illegible] with it, and on the sheet iron be eaten away, the cement still retains the pipe form. [illegible] again have been used, but are liable to be [illegible] in, and asphalted concrete is often preferred to hydraulic cement concrete.

Whatever system of pipes be used it is important that they should have smooth interiors and close joints, and [illegible] must be thoroughly well [illegible] so as not to be liable to displacement from above.

Mr. Verity then went on to describe the Chenoweth, the [illegible] Iron, the Irish, and J. E. H. Gordon's system as used by the Metropolitan Electric Supply company, [illegible] the cables are drawn into an iron pipe, and [illegible] iron pipes are led from the house junction boxes to the wires for house lighting. Testing boxes of a [illegible] and built of brick, are provided at intervals.

[illegible] important point in under- [illegible] good manholes. W. D. Sargent, in a [illegible] Telephone association [illegible] it is almost impos- [illegible] chambers too large, [illegible] instances to [illegible]

[illegible] for conven- [illegible] is often a difficult [illegible] In one [illegible] octagon [illegible] feet, being [illegible] gasket, and [illegible] be read- [illegible] put in. [illegible] cement bottom [illegible] water, many [illegible]

It has been suggested some time ago that the curb stones should be removed from busy thoroughfares and replaced with a hollow [illegible], and the suggestion may bear fruit in the future.

As I still have to deal with electrical conductors, I cannot here refer to the general cost of laying conduits, as at one time I proposed doing. The principal cost, however, of laying them is in making good and this depends on the material of the road [illegible] macadam (varying from 5s. per square yard), whereas asphalt would be nearer 20s. per square yard.

The difficulty of laying any form of conduit in some of our London streets must, as I have already said, be very great. The last comer will of course feel this the most, and, although the Hydraulic Engineering company may have recently had much trouble to find room for their pipes, the Electric Supply companies again will have an easier task than the Telephone companies who are putting off the evil day.

As to what form of conduit is most suitable for London and our provincial cities there will be differences of opinion, but I trust the discussion following will narrow it down to a small issue, upon which such work can be undertaken with a tolerable surety of its lasting success.

There is really sufficient subject matter for a paper on conduits alone and in taking up the question of underground conductors, I propose to chiefly restrict myself to a consideration of conductors for high-tension electric lighting circuits.

With regard, also, to underground conductors for low tension work, I feel that the Edison system as at present laid down, is thoroughly capable of filling all the requirements of house-to-house distribution. Many companies in the States and elsewhere are using it, and at the downtown station in New York it has been at work for the past six years successfully. In the recent discussion on Prof. Forbes's paper several points of interest concerning the the Edison underground conductors were explained, which it would be unnecessary for me here to repeat. A full description of the latest developments of this system, with samples of the improved form of conductors, etc., are now on the ocean, and in the event of it being possible to provide another evening for a continued discussion of this paper, I shall be most happy to show and explain them.

Everyone must acknowledge the foresight shown in devising such a complete system of underground mains so long ago, and which, in spite of the all-round developments of electrical engineering not only holds its own, but is still far ahead in completeness of any system for low tension underground work. The Westinghouse company have, I understand, acquired the rights for Great Britain, and, presumably, will use it in donnection with large transformers for sub-centers. It may be also interesting to note that Messrs. Siemens have made *concentric* three-wire cables, which are being successfully used at Elberfeld, Geneva, and Mulhausen, and they state that the troubles from what would appear very complicated jointing have been satisfactorily overcome.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 4.—The centennial of the inauguration of Washington as the first President of the United States was celebrated during the week on a magnificent scale. The triumphal arch, the most beautiful sight in the city, spans Fifth avenue at Washington square. It was designed and constructed for the great celebration, and will be replaced in marble as a lasting memento of the occasion. The electrical illumination of the arch is of surpassing beauty, and only at night does the real splendor of the beautiful design show forth. With an immense column on either side of the street, across the tops of which spans the arch upholding in its center a pedestal and statue of Washington of heroic size, lighted with over 300 incandescent lights arranged so as to bring out the graceful lines and decorations, one entrance to Fifth avenue from Washington park is in fact a most magnificent sight.

The whole city was brilliant with electric light illuminations, and the designs were varied and beautiful. Some of the most noticeable were the Edison offices on Fifth avenue, below Fifteenth street, where the entire front of the building was brilliantly illuminated with bands and [illegible] of the incandescent light; the building of Stern Brothers on Twenty-third street was brilliantly illuminated with electric lights, the central feature of which was a shield displaying the national colors; nearly all of the [illegible] illuminations, but the Union [illegible] street commanded the attention [illegible] was radiant with red, [illegible] globes, arranged on long [illegible] first story to the [illegible] several hundred of the [illegible] that only the red [illegible] and afterward the blue, [illegible] An addi- [illegible] movement [illegible] backwoods [illegible] companion: "Jingo, [illegible] design [illegible] 'Mary' and [illegible] illumina-

In the industrial parade on Wednesday several of the electric companies were well represented. The "C. & C." Motor company, the Sprague Electric, the John Stephenson electric cars equipped with the Julien storage batteries, Chas. A. Schieren & Co. with their immense belting for dynamos—all had magnificent displays.

Col. S. V. R. Cruger directed the civic and military parade by means of a special telegraph wire that he leased from the Western Union. Stations were erected at differents points of the route, and equipped with an efficient corps of operators. When Mayor Grant turned to address the president an electric dispatch announced the fact to the officials at Governor's Island through the time ball on the Western Union building, and the salute was fired at the moment that Mayor Grant handed the address to the president. All the movements were directed through the means of this telegraphic communication, and many difficulties entirely overcome. It was a happy thought.

As foreshadowed last week in the WESTERN ELECTRICIAN, telegraphic rates are finally equalized, and the contract between the Western Union and Postal Telegraph companies has done away with the Mutual Union company. It is denied that there is a consolidation of the companies, but it is admitted that the agreement will put a stop to competition, which is all the Postal Telegraph company was seeking. There are prominent Wall street men who do not hesitate to say, however, that the two companies are virtually consolidated, and that the Western Union only permits the separate existence of the Postal Telegraph so as to have an instrument for fighting any new company which might be organized. There is a reduction of rates on long distances, principally between the Pacific coast and the country west of Indiana and the Mississippi River, and between points north and south. The reductions vary from 5 to 25 cents on messages of ten words. The advances in rates are for short distances. The rate between New York and Chicago is raised to 40 cents.

The work of cutting down the poles continued yesterday. Inspector Busbey and his men, in connection with Inspector Hess and his men, had all the poles in the vicinity of Fifty seventh street and Eighth avenue removed last night. They resume work to day through Fifty-eighth street to Sixth avenue, and will experience a difficult task, as there are about 100 wires attached to each pole in the street. Inspector Reilley removed the poles of the Western Union on Eighth avenue, in the vicinity of Forty-second street, but the electric light wires were left, as there is no conduit built for them.

Inventor M. L. Hussey of Menlo Park, who has secured a patent for a watch to run by electricity, has almost completed the formation of a company to manufacture his electric clocks and watches, and the work will commence in a short time. Mr. Hussey has been eleven years at work on his inventions and has secured patents on thirteen appliances necessary in the manufacture of his clocks and watches. There are four of these, including a marine clock. The peculiarity about them is the gravity movement, which, aided by a small electric current, moves the pendulums of the clocks and the large balance wheels of the watches. The battery is inclosed in the watch case, and with it the timepiece will run for a whole year without any attention. In time it is expected that five-year watches and clocks can be manufactured. The new watches and clocks contain only one-third as many parts as the ordinary instrument.

The recent statements of the failure of copper men to reach an agreement in Paris has led New York operators to consider the idea of getting up an American copper trust. Such an organization may be formed on the arrival of the Servia, which carries the Americans, should it transpire that they were unable to make an agreement with the French capitalists. W. H. T.

Detroit, Mich.

DETROIT, May 4.—Articles of association of the Commercial Electric company, capital $20,000, have been filed with the county clerk. The officers are: President, J. B. Moore, vice president and treasurer, W. H. Fitzgerald; secretary, Geo. E. Fisher. The company will go into the manufacture and furnishing of machinery for electric light plants. Mr. Fitzgerald has been connected with the Brush company in this city as superintendent for several years past, and resigned his position a week ago to enter the new organization. Mr. Fisher was formerly manager of the Accumulator company. The Cole Conduit company was also organized this week. It will introduce a new form of conduit of the wooden pipe order.

[illegible] at the outset there appears to be a misunderstanding between the inventor and exploiter. George W. Cook asks the court to terminate the partnership between himself and Charles E. Cole. Mr. Cook claims to be the inventor

of the conduit, and asserts that Cole has not kept his agreement in regard to furnishing money to push its sale.

The Detroit Boat Building company is now fitting up a small boat with the Woodward storage battery. Should the experiment prove a success, other and larger boats, it is said, will be built at once.

The bill authorizing gas companies to produce, furnish and sell electricity and electrical light, passed the house by a vote of 51 to 15. C.

Kansas City, Mo.

KANSAS CITY, MO., May 4.—The American Bell Telephone company scored a victory in the United States court in this city last week. In the suit brought by it against the Topeka, Kan., Water, Light & Telephone company for injunction and for damages for infringement of patent, the defendants moved to hold the case in abeyance until a decision had been given in the suit of the United States in the federal courts of Massachusetts against the Bell company to annul the latter's patents. Judge Brewer of the United States court denied this motion. He decided that as long as the Bell patents stood, there was nothing in common between the two suits, here and in Massachusetts, to give any reason for the one to depend upon the decision of the other. This ruling of the judge was a great surprise to the defendants who felt confident of a favorable ruling, and expected to operate until the determination of the Massachusetts suit which might not be for a year or so yet.

Mr. C. H. Cone, representing the Electrical Supply company of Chicago in this city, has been in St. Louis for several days on a business trip.

General Manager Bates of the Western Electrical Construction company has returned from a month's stay in Boston.

Charles D. Jenney, formerly of the Fort Wayne, Ind., Jenney Electric company, has been visiting in Kansas City. Mr. Jenney is now devoting his attention to a new electric motor. The successor in his position with the Jenney company is J. J. Wood.

F. S. Terry of the Chicago Electrical Supply company, and J. B. Wallace of the Ansonia company, were in the city last week.

The Edison Electric Light company is now operating three 1000-light machines in its new power-house at Seventh and Wall streets. Three more machines of the same capacity will be in operation by fall.

Work has begun on the addition to the power-house of the Kansas City Electric Light company. The horse-power will be increased from 800 to 1,300. The capital stock of the company has been increased from $200,000 to $300,000.

Charles Rusling, the Thomson-Houston agent, has secured the contract for a 50 arc light plant at Troost park.

W. J. Clark, general agent of the Thomson-Houston railway department, was in the city last week.

Harry Lasell, brother of Secretary Lasell of the Southwestern Electrical Supply company, was drowned last week while on a fishing expedition at Bean Lake, a few miles north of here. He fired a gun while standing in a boat and the recoil caused him to fall into the water. As he was unable to swim he soon sank. He was just 21 years of age. He was superintendent of the Southwestern company's warerooms.

P. H. Alexander, general manager of the Sawyer-Man Electric company of New York, was in the city last week.

The Missouri Phonograph company has announced that it is ready to supply machines.

Mr. W. B. Grimes, jr., secretary of both the Kansas City and Edison Electric Light companies, left last week for New Mexico. He will spend a few days on his father's ranch which is located there.

Mr. F. J. Pilgrims, formerly manager of the Rich Hill, Mo., electric light station, has recently purchased the plant from its former owners. He will soon begin the construction of an electric light plant at Monett, Mo., the company having secured a twenty years' franchise from the city. They will start 10 arc lights at first, and will light the hotel with incandescent lamps, using same system of storage batteries, charging them from the central station.

Arrangements are now being made to extend the Vine street motor line to Ivanhoe park, a distance of about one mile from the city limits. It is expected that the change from steam to electric power will be made on this line between June 15th and July 15th. All of the right of way within the city limits has been secured.

M. D. Wood, the local manager of the Western Union, has announced himself a candidate for membership in the upper house of the council.

J. O. Stockwell, who has charge of the Kansas & Missouri Telephone company's exchange at Burlington, Kan., recently took out a patent for what he calls an "induction killer," which prevents the humming, roaring noise made over the wires where they are strung [illegible] electric light [illegible]. The company [illegible] ing all such [illegible] reserving only the privilege [illegible] the same [illegible] own district, free from [illegible]. Hon. John F. M[illegible] president of the Telephone [illegible] and also of the Topeka National Bank, has [illegible] letter from the general offices of the Bell Telephone company, requesting him to send young Stockwell [illegible] once, with his induction killer, and it [illegible] probable [illegible] lucky inventor, who leaves for the east this week, will realize a handsome sum from his discovery.

General Superintendent W. W. Smith has received an offer of $15,000 for the use of an electrical device he has invented and patented in two cities alone [illegible] the attaches of the exchange have been offered $25[illegible] for a patent on an improved fire alarm signal. I.

San Francisco, Cal.

SAN FRANCISCO, April 30.—The Westinghouse Electric company, through its agent, W. C. Clark, is installing another 750-light alternating plant, and a 65-horse power Westinghouse compound engine at the Bolivia hotel [illegible] city.

The newspapers have been agitating the subject of underground wires, and to give their articles a substantial basis they interviewed the leading lawyers of the city, and also several capitalists, ignoring, with one exception, I believe, all the practical electricians of the city.

The American company is making decided progress with its new station on the sea wall, having installed a second 50 light 2,000-candle power dynamo. The company reports the demand to be greater than it is able to meet. Having been refused a franchise by the board of supervisors, it obtained an injunction restraining the chief of police from interference, and, putting on a large force of men, started in, putting up poles and lines. The city authorities are now endeavoring to secure an injunction to restrain the company, but thus far it has not been granted.

The Simplex Electrical company of Boston has appointed Samuel H. Taylor as its representative on this coast.

The local supply companies all report business booming.

W. G. C.

Louisville, Ky.

LOUISVILLE, May 4.—The Gaynor Electric company of Louisville accepted an order last week from a Milwaukee firm to make eighty-five fire alarm and police signal stations, and thirty fire alarm registers.

Col. Wood, chief of the Louisville police, has recommended to the municipal government the use of a new fire alarm and police signal station combined, and strongly urges their adoption. He says that it will increase the efficiency of the force, and be the means of saving money to the city. It is proposed that the central police station be connected with every "beat" in the city, thereby affording communication with every officer. It is thought that the new system will prevent the great majority of false alarms sent to the fire stations, which cost the city annually hundreds of dollars.

A thief was detected here last week by an ingenious scheme improvised for the occasion by George Buckle. One of Buckle's friends had been very much annoyed by raids made nightly upon his pigeon cote. Buckle connected the cote with a bell in his friend's room, the arrangement being such that an alarm would be sounded if the cote door was disturbed. The plan worked admirably; the thief was detected, and fined in the police court. Mr. Buckle claims to have invented an electric battery which will be an improvement and a saving of material. He is not yet ready to reveal his discovery.

By May 1st the Ohio Valley Telephone company will have an exchange in operation in New Albany. Jeffersonville's new exchange was opened April 1st. The Louisville exchange is already connected with each city by six trunk lines, which are carried across the bridges to the respective Indiana cities. These cities had exchanges before the Indiana legislature passed the Williams telephone bill, which has been recently repealed. Subscribers in New Albany and Jeffersonville will now be charged $4 per month for local service.

The Ohio Valley Telephone company has completed its half of the line which is to connect Louisville and Cincinnati, and only the construction of the Cincinnati company is needed to bring the cities into closer connection. The Ohio Valley Telephone company is negotiating with a similar organization in Indianapolis for telephonic connections, and it is likely that the two cities will soon be linked together with the best of speaking facilities.

The recent improvements of the Ohio Valley Telephone company have made its system one of the best and most complete in the west. Its 2,100 subscribers give Louisville's exchange more lines than any other city in the

[illegible]

An annual exp[illegible]

[illegible]

The iron and steel wires are being rapi[illegible]

[illegible]

Pittsburg, Pa.

P[illegible], PA., May 4.—The [illegible] pany of this city lately [illegible] peculiar circumstance. On the morning [illegible] servant [illegible] the Windsor hotel, M[illegible] odor of gas issuing from a room occupied by [illegible] from the rural districts. The occupant, when found, [illegible] nearly dead, but after a time was restored to conscious[ness]. He had blown out the gas on retiring the night before. A representative of the Marr company was stopping a[t the] house, and on learning the circumstance took occasion to impress on the landlord the advantages of electricity over gas. He assured the proprietor that the only way to save big bills caused by his boarders blowing [illegible] instead of turning it off, was to put in incandescent electric lights. The proprietor closed a contract with the drummer, and the Westinghouse system will be used.

The court house tower was lighted by electricity [illegible] week. Superintendent J. C. Mercer stated that the lamp would be of 2,000-candle power. The effect was beautiful, and showed the fine work of the tower to advantage.

L.

Aurora, Ill

AURORA, May 4.—The Aurora Electric Light [illegible] company, after a successful year's work, has found it necessary to increase its plant to double its present capacity. Finding its present station entirely too small, it decided to erect a building for its own use exclusively. The company has now nearly completed a substantial brick building, into which it will move about the 15th of the present month. The steam plant is to be an entirely new one. The Hazleton boiler is of 200 horse power. Two 100 horse-power Westinghouse compound condensing engines with Dean condensers, will be employed. The entire constructing and fitting up of the plant is under the immediate supervision of W. Meridith, superintendent of the company.

L. W. C.

Minneapolis, Minn.

MINNEAPOLIS, May 1.—A dispatch from Fargo [illegible] says: The Fargo Gas & Electric company have contracted for lots adjoining the gas works, and will [illegible] solid brick building for the incandescent light plant [illegible] will consolidate the incandescent and gas plants [illegible] the power, and, as soon thereafter as possible [illegible] lights through the residence portions of this city [illegible] head. The new machinery has already been [illegible] for and the new building is to be completed by May 15th.

L.

Knoxville, Tenn.

KNOXVILLE, May 4.—Knoxville, Tenn. [illegible] an electric road. The following residents [illegible] rated the Riverside Electric Street Railway [illegible] John M. Brooks, W. A. Park, C. A. F[illegible], W. W. [illegible] ming and [illegible] W. Arthur. A charter [illegible] The road will start near the [illegible] Knoxville and West Knoxville to Lyons View [illegible] of six miles. In reference to the advantages [illegible] from the road, the Knoxville [illegible] construction of the road will be [illegible] ville need not be said. It will bring [illegible] of that portion of the country to the west [illegible] and along the river shore. That portion [illegible] rapidly develop into one of the [illegible] properties, and the building of the electric [illegible] soon bring it about."

All the right of way has been secured except through [illegible]

[illegible] anticipated from [illegible] road. Work [illegible] to completion [illegible] H.

St. Louis, Mo.

[illegible] of the Atwood [illegible] made. It was at [illegible] The light was [illegible] were connected [illegible] a space 2x4x2 [illegible] dynamo lamp and [illegible] this city formerly [illegible] Houston company [illegible]

[illegible] company is erecting [illegible] The plant will be a model one. The company is installing 50,000 Westinghouse incandescent dynamos, 5,000-horse power of Westinghouse [illegible] power Babcock [illegible]

[illegible] is installing another 125-horse power 4-valve Russell engine, making three [illegible] seven engines and eight 500- [illegible] B.

Pine Bluffs, Ark.

[illegible] May 4.—The city contract for [illegible] lighting has been awarded to the Water & Light company, an organization which has been operating here since last December. The contract is for seven years, and provides for lighting the business part of the city with Thomson-Houston arc lights and the residence parts with 25-candle power incandescent lights. The lighting district includes the whole city, and will require liberal extensions to the plant already in operation. The company is pushing its work, placing new boilers, engines, dynamos and other machinery, and extending its street lines. The alterations and extensions are being made under the [illegible] Engineering company of St. Louis [illegible] the system will be completed [illegible] M.

St. Joseph, Mo.

[illegible] May 4.—An immense mass meeting was held at Tootle's opera house last week, the object of which was to promote the interests of a proposed mammoth mechanical exposition here this fall. The incorporators of the enterprise are among the wealthiest and most enterprising residents of the city, and the large attendance gives assurance of ample financial backing, creating confidence in the project, which promises to be one of the most extensive projects ever suggested in the west.

The common council met last week and passed the [illegible]

The Union line is now running its electric cars to Fifth [illegible]

[illegible] "corkscrew" [illegible] house near the [illegible] D.

Indianapolis, Ind.

[illegible] company of [illegible] Welding [illegible]

[illegible] lephone company in [illegible]

THE ELECTRIC LIGHT.

[illegible]

[illegible] used, but further investigation [illegible] they have decided to have their town lighted by the Heisler system [illegible]

[illegible] a contract with the [illegible] arc lights for street lighting [illegible] so placed that all parts of the city will be benefited.

The San Francisco Underground Conduit Electric Light, Telegraph & Telephone company has applied for a franchise to construct [illegible] for the conveyance of electric light, telegraph and telephone wires.

The new incandescent electric light plant at Omaha, Neb., was started up [illegible] worked splendidly. There is but one dynamo yet in operation, that being the smaller one of 750 lights. The 1,500 light machine will be started as soon as the [illegible] are set. Until that time only the lights on Middle Broadway will be lighted.

Pittsburg, Pa., boasts of being not only a clean city, but also the best lighted in the country. A representative citizen recently interviewed by a New York reporter, said: "You may gather some idea of how that comfort and protection [illegible] when I tell you that four years ago there were 300 electric lights in Pittsburg, and now there are 30,000."

Richmond, Va., is taking measures toward owning and operating its own electric light plant, and lighting the entire city with electricity. After the city council's subcommittee on finance and electric lights had had a discussion upon the advisability of such an important change in the city's illumination, the matter was continued a month. In the meanwhile the cost of erection of the plant and other details will be looked into.

A Jamestown, N. Y., correspondent writes: The electric light question is again brought forward by the proposition of a representative of the Western Electric company. The company offers to put in a plant capable of operating 100 arc lamps of 2,000 candle power each, and 15 miles of wire for not to exceed $15,000, the city to furnish building and site. Bonds are to be given by the company that the operating expenses will not exceed $4,650 per year.

Electric light in street cars by means of the incandescent lamp is certainly a vast improvement upon kerosene oil, says the *Street Railway Journal*, which, no matter how carefully looked after, persists in smoking, smelling and leaking; and we hope at no distant day to see all street cars, whether propelled by the electric current or other forces, provided with this beautiful light by means, perhaps, of storage batteries, which in some methods of traction could have their charge of current replenished during the daylight running of the car.

A correspondent, in a letter devoted to booming New Birmingham, Ala., writes: An electric light plant, costing $25,000, is nearly completed. The poles are being erected and wires placed in hotels and business houses. It is the Westinghouse incandescent system, and is owned and will be operated by the New Birmingham Electric Light, Power & Street Railway company, of which M. D. Mather of Austin, Tex., is president, and J. W. Needles of Philadelphia, secretary. There are also two street railway lines chartered, one to be operated by steam, and the other by electricity.

During the latter half of April the Westinghouse Electric company received orders for alternating current outfits as follows: Jonesborough, Ark., 750 lights; Westerly, R. I., 500 lights; Newark, N. J., 750 lights; Ottawa, Kan., 750 lights; Ashland, N. H., 500 lights; Minneapolis, Minn., 600 lights (increase); Auburn, Me., 750 lights; Traverse City, Mich., 500 lights. The total of orders for the month of April aggregate 15,850 16 candle power lamps capacity. About one-third of the central station companies using the Westinghouse system have increased their capacity since starting, in most cases at least doubling their original output.

A Cincinnati paper says: The Lockland council met Wednesday night for the purpose of considering the light question. The Central Thomson-Houston company and Wyoming Water, Heat, Light & Power company were before them with their propositions and requesting the right of way to construct their wires through the streets. After some lengthy discussion it was decided that both should be given the right of way and the solicitor and [illegible] accordingly, and [illegible] charged consumers. The Thomson-Houston company will be [illegible] within sixty [illegible]

[illegible] age of electricity [illegible] assume that [illegible] supplant [illegible]

[illegible] half the night through [illegible] candle. Now a 20 candle power light scarcely suffices for the task." The gas official in question admits that in great centers of population electric lighting is far more economical than gas, and its superiority over all other forms of illumination is, of course, conceded.

A St. Joseph, Mo., paper of April [illegible] speaks of the progress which is being made toward completing the plans for the city electric light plant. Last Friday night the city's electric light committee met and decided on the location for the towers and single lights that are to be used hereafter in lighting the city, and appointed the mayor, city engineer and chairman of the finance committee to select the location for the power house. A piece of ground near the Union depot has been selected, but it has not yet been fully decided to accept the location. The towers are guaranteed to throw a light 1,700 feet in every direction. Care has been taken to so place the towers, each of which contains four lamps, as to almost encircle the outskirts of the city with a continuous chain of lights, and if the lamps perform the work guaranteed, then the extreme limits of the city will be almost as well lighted as the heart of the town. The single lights are placed at alternate corners, each lamp being expected to illuminate four blocks, one in each direction from the lamp.

The Illinois Valley Electric Light & Power company has been organized at Ottawa, Ill., to operate in the cities of Ottawa, Marseilles and Seneca, all located on the Illinois river. In view of the fact that the water power privileges at Ottawa are controlled by rival companies, the promoters of the new enterprise were compelled to look elsewhere for a location. The next best point being Marseilles, it became necessary to select a system which could be operated successfully at this distance. After some months of investigation the company closed a contract with the Heisler Electric Light company of St. Louis. Ottawa is located near the center of La Salle county, and is eight miles from Marseilles. Seneca is located near the county line, and is three miles from Marseilles and thirteen miles from Ottawa. The amount of water power available at Marseilles is practically unlimited. The plant now being installed will be of a capacity of about 700 30 candle power lamps, but it will soon be increased to 2,000. It is expected that this capacity will be required for the public, commercial and domestic lights in the three cities.

THE ELECTRIC MOTOR.

An electric railway is contemplated at Ludington, Mich.

The Windsor, Ont., street car line will be operated by electric motors.

The Appleton, Wis., electric road is to be extended to Appleton Junction.

In all probability an electric railway will be constructed from Altoona, Pa., to Hollidaysburg, a distance of four miles.

The City Railway company of Sioux City, Ia., has been given a fifty years' franchise to operate its lines by electric motors.

The trial trip of the electric motor car on the Crescent City Railroad company's road in New Orleans was made last week. The experiment was in every way successful.

It is stated that the Des Moines street railway, which George B. Kerper of Cincinnati recently purchased will be operated by electric motors, but the system has not been determined.

John H. Maxson of St. Louis is quoted as saying: "I do not believe there will be another cable street railroad constructed in St. Louis. I think it is rendered improbable by the rapid progress being made in the overhead wire electric system."

A delegation of officers and stockholders of the National Electric Tramway & Lighting company of Victoria recently visited Seattle, W. T., to inspect the plant of the Seattle Electric Power & Motor company. The Victoria company intends to put in an electric railway in that city. It is likely the plant there will be made a duplicate of the Seattle railway.

The Union Pacific management has not abandoned its idea of running a motor line across the bridge from Omaha to Council Bluffs, and according to the statement made by an official, will abandon its Broadway depot in the latter city, and run to the Main street depot, leaving its Union avenue line for a motor line. The management believe that in the future the north side travel will be sufficient to make the project a paying one.

The Salt Lake City *Herald* says the Sprague Electric railway will be in operation in that city about July 1st. It quotes a representative of the street car company as saying: "The cars are now being built by the Stephenson company, and they will be far in advance of anything of the kind ever seen here. They will be sixteen feet in length, and capable of seating at least thirty passengers comfortably. They will be built on the newest principles, and the equal of anything run in any other city in the world."

The project of constructing a street railroad from Columbus, O., to Worthington is becoming of more and more interest to property owners in these places, and is also attracting the attention of capitalists. Men of experience in constructing and operating both cable and electric roads have been consulted, and from estimates which have been made it is believed an electric street railroad could be built from North Columbus to Worthington, a distance of almost five miles, for $8,000 a mile, and the cost to operate it would be from $10 to $14 per day. The property owners along the proposed line have signified their intention of subscribing to the enterprise. It is thought that subsidy can be secured for the entire line, and that residents of Worthington and along the line will become sufficiently

interested in securing the right of way and otherwise aiding the enterprise so that the road can be pushed through the coming season.

During last week the Sprague Electric Railway at Atlantic City was started, and the operation of the road on the trial trip of the cars was perfectly successful, and the cars ran over the entire distance of the road at a speed exceeding 15 miles an hour, drawing another car behind them. A number of the officials of the road were present and expressed great satisfaction at the operation of the cars, their ease at starting, and in rounding the curves. The equipment of this road includes new 15 horse power motors. This system of roads at Atlantic City, which is now being completely equipped with electricity, is controlled by the Pennsylvania Railroad company.

A Council Bluffs paper says: The city council have now in hand an ordinance granting to a new company the use of nearly all the now unoccupied streets for the occupation of an electric system. This, if granted, takes in the southern approach to Omaha. The present operating company is enlarging its plans as rapidly as possible. It has now two Westinghouse engines, giving 250 horse power. It is adding two more and five 80 horse power generators. The present capacity of the plant has not been necessary to operate the line as it now is, and with this increase, which is fully threefold, the company can operate more than three lines to the present mileage. The extensions of the line will in time include the Chautauqua assembly grounds. In fact, if the line is not extended to that point within a short time, it is said the other company will secure the necessary franchise and run a line there. Thus Council Bluffs will be adequately supplied with means of transportation in all its parts.

The Omaha *Herald* editorially refers to the street railroad fight in that city as follows: "Ever since the motor railway company began building operations under the franchise freely granted by vote of the people, there has been a disposition on the part of the Broatch administration, inspired of course by rival street transit corporations, to harass and delay the construction operations of the motor line. The *Herald* has no special consideration for either Dr. Mercer or his colleagues in referring to this; neither is it blinded by the sophistries of those who have sought to crowd him to the wall. In expressing its views here it is moved purely by that desire for public good—the lack of which, in the board of trade, it has censured so freely. It is not a twelvemonth since the ability of the electric motor to complete their enterprise was generally doubted. The haphazard, here-and-there efforts made last year to occupy certain streets and crossings, to the general discomfort and inconvenience of the public, made the enterprise a nuisance. Coupled with this was a suspicion that the enterprise was a purely speculative one, and that it would be speedily consolidated with either the horse car or cable lines. Twelve months have demonstrated the fallacy of that theory. The consolidation has been that of all the other lines against the electric motor, and that consolidation, judging by the actions of the city authorities, seems to have included the municipal government. All the obstacles that could be devised, from Broatch's raid on the poles to the board of public works' refusal to grant permits to rush the work of construction, have been used to hinder the completion of this splendid feature of urban life. But over all obstacles the motor railway is triumphing. Sufficient capital has been secured, injunctions have been defeated, and the work has been advanced sufficiently far to demonstrate the success of the electric motor for purposes of rapid street transit."

That the superiority of electricity for street car propulsion is manifesting itself, is evidenced by the following article from the *National Car Builder:* "The most objectionable and most expensive method of operating street railroads is by horse power, and the prolonged survival of this barbarous means of propulsion has been due in a great measure to the want of a satisfactory substitute. It looked for several years as if the cable system was destined to supply the most efficient and economical means of transmitting power for the propulsion of street cars, but lately various electrical appliances have proved so much superior to the cable as a substitute for horses that the indications now are that electricity is the coming medium through which steam engines will operate street cars. There are few large cities that have not one or more lines of street railways operated by electricity, and the number of companies that are substituting this form of traction in place of horse power is very large. At present electricity is conveyed to the motor which drives the car principally by conductors leading from a central station where the electricity is generated, but the experience with storage batteries indicates that the practicability of each car carrying its own power in storage cells is very promising. The aldermen and other officials comprising the municipal government of cities are not displaying much disposition to encourage the development of electrical methods of operating street railways, and many of them offer very active opposition. The opposition to this line of improvement is decidedly discreditable to all concerned, for the change from horse to electrical traction is a benefit to the community in several ways. It increases the cleanliness of the streets, and makes them much easier maintained in good order, and it greatly decreases the noise of operating. Cars operated by electricity are much more comfortable to ride in than those pulled by horses or cables, for there is none of the jerking in starting which characterizes the latter means of applying power."

THE TELEPHONE.

The following paragraph is taken from the London *Electrical Engineer:* "With the consent of the pastor and deacons of the Congregational church at Tunbridge Wells, the South of England Telephone company has been experimenting with their instruments with a view to perfecting the transmission of a religious service to distant and scattered parts of a locality. Telephonic communication having been established within the [illegible] service on Sunday was listened to by about a [illegible] gathered at various points in the town. One [illegible] doctors and chemists assistants on duty at their [illegible] establishments joined with the congregation in the [illegible] as did also an invalid lady who has been bedridden [illegible] long time."

In the Delaware legislature last month the special committee on telegraph and telephone taxation reported to the house a substitute bill imposing a tax on telegraph and telephone wires of 60 cents per mile per annum for the first wire, 30 cents for the second and 20 cents for each subsequent wire. The bill reported was then taken up and passed by the house, and is understood to be satisfactory to the telegraph and telephone companies.

A novel application of the telephone has been made on the railway between Saint Valerie-sur-Somme and Caveux, France, with a view to facilitate communication between a train broken down on the line and the nearest station. The stations themselves are on this line already in telephonic communication by means of an overhead wire; and the guard's van of an experimental train was fitted up with a telephone, with battery of ten Leclanche cells and a [illegible] bell. One pole of the battery is put to earth by being connected to the framework of the guard's van, and the other is joined in the usual way to the telephone, the other terminal of the latter being connected with a wire by which connection with the existing telephone line can be made at any point. To facilitate this operation the wire is inclosed in a light steel tube, long enough to reach the overhead wire from the roof of the van, and provided at the end with a hook for attachment. Upon ringing up, the stations in front and rear of the train receive the signal, and conversation can be carried on with both simultaneously. The object of this arrangement is to enable the guard of a train delayed or broken down on the line between two stations to call for assistance. The apparatus carried in the guard's van is self-contained, inclosed in a box and weighs only about twenty-five pounds.

THE TELEGRAPH.

During a thunderstorm at Jasper, Ala., last week, lightning struck the telegraph lines, and Frank Hurd, an operator, was killed.

The Western Union company was recently compe led to remove a line of poles in Milwaukee, as they seriously marred the appearance of one of the streets.

A dispatch from Portland, Me., says: The Commercial Union Telegraph company of Maine has been leased by the Commercial Union Telegraph company of New Y. rk.

In Judge Field's court in Kansas City, Mo., May 1st, the attachment suit of E. L. Martin against Ed S. Stokes of New York was compromised and the case dismissed. By the terms of the compromise the controlling interest in the Postal Telegraph company, representing 2,092 shares, passed to William Mackay, the California millionaire, and one of the proprietors of the Bennett-Mackay cable. March 1, 1888, E. L. Martin of Kansas City, president of the Pacific Mutual and Pacific Telegraph companies, sold to E. S. Stokes, proprietor of the Hoffman House in New York, 1,056 shares in the first mentioned company, and 10,36 in the last named, for $89,060. An agreement in writing was entered into between the parties, Stokes agreeing to pay $44,350 of the purchase price on or before March 1, 1889. When the note fell due Stokes refused payment, and Mr. Martin began suit. A note for $21,159, held by the Pacific Mutual company and payable to Stokes on demand, was attached by Mr. Martin at the same time. The stock of the Pacific Telegraph company was selling at 50, and the Pacific Mutual at 35. Mr. Martin, who is president of the postal system west of the Mississippi, said last evening that there would be no change in the officers of the company. "The suit," he said, "was simply compromised on an agreement made between Mr. Stokes and Mr. Mackay, by which the latter assumed the indebtedness and took charge of the stock. Mr. Mackay now has control of the entire Postal Telegraph system and the Bennett-Mackay cable."

An illustration of the increase in cipher telegraphy is found in the statement of Sir James Anderson at the general meeting of the Direct Spanish Telegraph company, limited, at London, Eng. During the last six months this company transmitted 2,000 more messages than in the previous half year, but these messages contained 27,000 less words. This means, of course, a loss to the company. The comments on this subject continue: "The average length of the telegrams has fallen about three-quarters of a word. We are face to face with a natural desire of all merchants to economize all the money they can, and to make their telegrams as short as possible. I do not know what they are going to come to, but it is quite obvious that if they go on reducing the length of the messages to, say, only one text word, it will be impossible to pay anything. I find on investigation that there are an enormous number of telegrams sent to the east consisting of three or four words only, and a three-word message does not pay at all. Whether anything will be done to alter that at the conference I cannot say, but it is remarkable that whenever I come before you I have to say the same thing that the messages are getting shorter and shorter, and that while we are carrying more of them we are getting no more money. There is a decrease of £305 in the traffic receipts compared with those for the corresponding period of the previous year. That, however, is not owing to a falling off in trade generally, but through the failure of the fruit trade. This year the fruit was as bad as it could be, and it nearly all went rotten at sea. Formerly this would have been a more serious matter with us, because a few years ago the telegrams were all about fruit and shipping, but now, since the commercial treaty was framed, we have a more miscellaneous class of messages."

Miscellaneous Notes.

[illegible]

[illegible] because of his remarks [illegible] swears that the reporter [illegible] and then ran them [illegible] newspaper worker [illegible] living which he does not deserve.

The following is taken from the [illegible] April 21st: Last Thursday night [illegible] one story brick structure 214 [illegible] oil cup factory. There was an electric motor in the room where the fire occurred, and the wires which supplied the current were strung from the street [illegible] room and down a partition to the motor [illegible] with Capt. DeLancey Haven, [illegible] Baxter and others of Engine Company No. [illegible] the scene. John McKinney of truck [illegible] attempt to cut the wires leading to the motor. Armed with rubber gloves and gutta percha shears he [illegible] the wires. At the first clip he uttered a yell and fell in a heap, badly shocked. He left for home, and has since been off duty and under the doctor's care. Lieut. Moore rubbed against a wooden partition, received a severe shock and yelled lustily. At the same instant that Moore touched the partition Capt. Haven brushed against M[illegible] latter was also sev. rely sho.ked. There were half a dozen men in the room, and there were constant yells as each felt the effects of the deadly current. Everything they touched seemed full of electricity. The floor seemed charged, and the men danced an involuntary hornpipe. They finally got out with no more serious damage than that done McKinney. The supposition is that the water dripping from the wires had charged all the woodwork in the room, and also the floor, a new and exceedingly interesting phase of electrical danger. The men learned afterward that the switch of the motor was half open. It was at [illegible] intention of the men to put the pipe of the chemical through a window, and had this been done and the [illegible] nozzle of the pipe come in contact with the motor with the result of the electricity following the chemical fluid back, there would doubtless have been three or four deaths.

Business Mention.

A. H. Lewis, Chicago manager of the C. & C. Motor company, has moved his office to room 405, Phenix building.

John G. Boyd, formerly of the Queen City Electric company of Cincinnati, has accepted a position with the [illegible] F. Card Manufacturing company of the same place.

F. E. Degenhardt, western manager of the Standard Underground Cable company, has sold the [illegible] Power company of Minneapolis, Minn., five tons of weatherproof line wire.

Woodbridge & Turner of New York are rapidly completing the construction work for the Sprague electric railway at Chattanooga. This will complete the work on the Sprague road at Marlboro, Mass., June 1st.

The Fidelity Carbon & Manufacturing company has commenced the supply of electric light carbons [illegible] and factory at 2134 DeKalb street, St. Louis. The "Diamond" carbon is well spoken of, and [illegible] its sale is to be vigorously pushed.

The Sperry Electric Mining Machine company of Chicago has been organized. The officers are [illegible] Albert L. Sweet; secretary and treasurer, Herbert E. Goodman, electrician, Elmer A. Sperry. The [illegible] ers of the company are at room 35, 175 Dearborn street.

The Pond Engineering company of St. Louis, Mo., has opened a branch office in Chicago [illegible] Insurance building. They also have a [illegible] Kansas City. The business of these [illegible] has been rapidly extending. They now [illegible] necessary.

On May 15th the National [illegible] New York will commence to lay underground [illegible] on Milk, School, Washington, [illegible] India streets, Boston, for the [illegible] New England Telephone company. Mr. [illegible] the company has just invented [illegible] which is said to possess many [illegible]

George L. Fisher, formerly manager [illegible] Accumulator company in Detroit, and W[illegible] formerly manager of the [illegible] of Detroit, have organized the Detroit [illegible] company, which will deal in general [illegible]

will also make a specialty of electrical engineering and con- [illegible] will be at 53 and [illegible]

[illegible] Regulator com- [illegible] the Tremont Nail [illegible] This is the third [illegible] The company is [illegible] Alexander Bay & [illegible] Carthage, N. Y. [illegible] ance trap that auto- [illegible] the hot well.

The Westinghouse [illegible], of Pittsburgh, Pa., [illegible] oughly appointed [illegible] are invested here. [illegible] America have visited the company's establishment, while the largest [illegible] have visited Pittsburgh, principally with this object in view. The company seems [illegible] facture, so that all [illegible] competitors, are cordially received. Its product consists exclusively of steam engines, whose distinctive feature is that they are capable of transmitting their entire power to actual work. In other words, one of their 100-horse power engines will deliver 100-horse power onto the belt, and requires only a 100-horse power boiler to operate it, and the regular consumption of fuel necessary to produce 100-horse power. Agencies are now in full operation in all parts of the United States, Maritime Provinces of Canada, Mexico, Central America, South America, Austria, Italy, Spain, France, Holland, Denmark, Norway and Sweden, Russia, [illegible] agency contracts are now in negotiation for England, India, Turkey, Japan, etc. Despite the low wages paid in England and other European countries the Westinghouse company finds a ready market there for its engines, though, of course, the home companies can undersell it. This speaks well for the merits of the machine.

Personal Paragraphs.

Enos M. Barton, president of the Western Electric company, Chicago, left for New York May 1st. He will sail on May 11th for Europe, and will be absent about three months.

Frank L. Pope of New York was in Chicago last week. He testified in the case of LeRoy B. Firman against the New Haven Clock company, an infringement suit relating to the plaintiff's American District 11 call boxes.

C. Kammeyer of the National Electric Manufacturing company of Eau Claire, and Miss Daisy Isaacson, daughter of General Isaacson of Eau Claire, were married last Sunday at the residence of the bride's parents. Mr and Mrs Kammeyer are now on their wedding trip in the east.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, reports the following quotations of telephone stocks:

[illegible]	300	305
[illegible]	49	50
[illegible]	80	81
[illegible]	31	33
[illegible]	39	40
[illegible]	40	41
[illegible]	67	69
[illegible]	116	117
[illegible]	150	153
[illegible]	22	25
[illegible]	65	67

Electrical Patents.

[illegible] 1889.

[illegible] Charles [illegible] Gunar, Fl. [illegible] with an opening [illegible] or grapple [illegible] and adapted also to [illegible] electro-magnet, [illegible] combination [illegible] for operating the [illegible]

[illegible], O.

[illegible]

[illegible] ing circuit [illegible]

[illegible] rcuit, and [illegible]

402,191. System of [illegible] Secondary Batteries. George B. Prescott, Jr., Newark, N. J.

First and three [illegible] nded:

"1. The combination [illegible] primary generator of electricity located at a main station, a charging circuit, a secondary battery located at a sub station, a working circuit therefor, one [illegible] cells yielding a counter electromotive force to [illegible] introduced and withdrawn with respect to the working circuit, a switch or circuit-changer controlling the position of said cells, an electro-magnet for operating the switch, and a separate circuit connecting the [illegible] sub-stations, including the coils of said magnet."

"3. The combination of a primary generator of electricity located at one station a secondary battery located at a second station, a charging circuit uniting said stations, a working circuit for the battery, one or more cells yielding a counter electromotive force to be inserted and withdrawn with respect to the working circuit, a circuit connecting points in the working circuit at one station with an indicator at the other station, an electro-magnetic switch at the sub-station controlling the counter electromotive force cells, and an electrically independent circuit uniting both stations and controlling the electro-magnetic switch."

402,192. Distribution of Electricity by Secondary Batteries. George B. Prescott, Jr, Newark, N. J.

The seventh and last claims follow:

"7. The combination of a primary generator of electricity located at one station, two or more series of cells of secondary battery located at sub-stations, a charging circuit uniting all said stations, a working circuit for each series of cells containing translating devices a series of cells for each working circuit yielding a counter electromotive force with respect to the battery, a switch or circuit changer for successively introducing or withdrawing said cells with respect to said working circuit, and means for automatically operating said switch, consisting of an electro-magnet in a circuit connecting opposite terminals of the secondary battery and an electro-magnet in a local circuit having its armature connected with said switch.

"10. The combination of a suitable source of electricity a working circuit therefor containing translating devices, such as lamps, in parallel circuit with said source of electricity, a suitable device in series with said source of electricity between the battery and translating devices for producing a drop in electromotive force, and a magnet in a circuit uniting opposite terminals of said source of electricity for introducing and withdrawing said device with respect to said circuit."

402,200. Pole-Piece for Dynamo-Electric Machines. John G Statter, London, County of Middlesex, England.

Claims 1 and 2 are: "1. A dynamo-electric machine or motor having one or more of its pole-pieces cut away or incised, intermediate of the extremities of said pole pieces, to vary the length of the conductor acted upon and keep constant the magnetism generated in the coils passing under the brushes, whereby, when said brushes are shifted, sparking will be obviated.

"2. A dynamo-electric machine motor having one or more of its pole pieces cut away or incised, intermediate of the extremities of said pole pieces, to make the inductive effect of the field magnets equal to the self induction generated in those coils of the armature passing under the brushes whereby the inductive effect and the self-inductive effect will neutralize each other, and no sparking will occur when the brushes are shifted."

402,249, Electric Cut-out. James L. Kimball and Herbert C. Wirt, Boston, Mass.

402,264. Multiple Switch Board. Charles E. McCluer, Richmond, Va

The testing apparatus consists of a local circuit with a battery and rheotome; this local circuit passes through the primaries of induction coils at each board, and the terminals of the secondary of each induction coil are connected to the switch plugs of a flexible cord, a testing plug being provided which is grounded through a receiver.

402,290. Electric Motor. Frederick Yeiser, Tampa, Fla.

402,298. Combined Telephone and Telegraph System. William Burnley, North East, Pa.

Of the fourteen claims, the following are given:

"1. In a combined telegraphic and telephonic system, the combination of undulatory current telegraphic transmitting instruments adapted to operate and maintain a continuous current over a main line, and telegraphic receiving instruments on said line, with telephonic transmitting and receiving instruments operating over said main line, and condensers between said telephonic instruments and said main line.

"11. In a combined telegraphic and telephonic system, the combination of undulatory current telegraphic transmitting instruments through which [illegible] current over the main line can continuously [illegible] receiving instruments on said line, telephonic transmitting and receiving instruments operating over said main line, and condensers between said telephonic instruments on said main line, with [illegible] adapted to operate [illegible]"

402,[illegible]. [illegible] Locomotive Engine. Sebastian Ziani de Ferranti, Hampstead, County of Middlesex, England.

The armature of [illegible] locomotive engine is placed [illegible] with it are aligned [illegible] they are then coupled [illegible] allow a limited amount of [illegible] other.

[illegible] in combination, with the frame [illegible] locomotive engine, of a dynamo electric machine placed between the driving wheels of the locomotive, with its armature concentric with the axle or axles of the wheels and flexing couplings between the axle and armature which allow the frame of the locomotive and the dynamo which it carries, to play up and down freely."

402,316. Engraving Machine. Charles H. Field, Providence, R. I.

402,329. Electric Striking and Repeating Clock. Alphonse M. J. Jansen and Vincent J. A. M. Jansen, San Willibrordo, Curacoa.

402,332 Electrical Gas Lighter. Daniel C. Knowlton, Boston, Mass.

Claim: "A gas burner and a cock controlling the passage of gas through the same, in combination with a lever attached to said cock and pivoted thereby in said burner, a pair of electrodes attached to said burner and said lever, a fixed pin, and a notched spring attached to said lever and engaging said pin, one of said notches being arranged to hold the cock open and the other to hold it closed by engaging with said pin."

402 347. Thermometric Indicator. William R. Patterson, Chicago, Ill.

402,349. Distribution of Electricity by Secondary Batteries. Matthias Pfatischer, New York, N. Y.

The invention relates to automatically introducing and withdrawing an artificial resistance by effects due to the presence or absence of the dynamo current, so as to maintain a constant difference of potential at the lamp terminals in the working circuit supplied by the battery, and to do this whether the dynamo is charging the battery or is disconnected therefrom.

402,367 Electric Belt. William L. Van Dorn, Brooklyn, N. Y.

402,398. Automatic Railway Signal. John T. Carter, Baltimore, Md.

402,408. Railway Telegraph. Frank J. Crouch, Oakland, Ore.

402,410. Electric Meter for Alternating Currents. Delamore L Davis, Salem, O.

402,414. Telegraphy. Mark W. Dewey, Syracuse, N. Y.

Claims 1 and 3 are given: "1. In the art of reproducing written characters electro-telegraphically, the method which consists in varying the strength of the line current formed of rapid impulses and causing such varying line current to actuate electro-magnetic devices to control the flow of ink or marking fluid of the receiving instrument.

"3. In the art of reproducing written characters electro-telegraphically, the method which consists in transmitting over a line circuit rapid electrical impulses of varying strengths, varying the strength of said impulses by the pressure exerted upon the transmitting instrument, and operating electro-magnetic devices at the receiving end of the line circuit by the varying electrical impulses to control the flow of ink or marking fluid of the receiving instrument."

402,415. Telegraphy. Mark W. Dewey, Syracuse, N. Y.

Claims 2 and 10 read: "2. In a writing telegraph, the combination, with the stylus or pen, of a variable resistance attached directly to said stylus or pen and moving with the same over the surface receiving the inscription.

"10. In a telegraphic receiving instrument, the combination of a bar having an operative end capable of universal movement within one uniform plane, a stylus or pen carried on said operative end of the bar and movable at right angles to the aforesaid plane, an armature connected to the stylus or pen, and an electro magnet or solenoid for moving said armature."

402,416. Method of Expanding Hoops or Tires. Mark W. Dewey, Syracuse, N. Y.

The third claim is given: "The method of expanding a hoop or tire preparatory to setting the same, consisting in circulating uniformly or substantially uniformly within the entire circumference thereof, an electric current of large volume."

402,420. Insulating Cut Off Joint. Harry M. Doubleday and Russell Doubleday, Pittsburg, Pa.

402,481 Incandescent Lamp Socket. Frederick C. Rockwell, Hartford, Conn.

The first claim is given: "The herein described shell for incandescent electric lamp sockets, formed of paper, the surfaces of which are provided with a coating of insulating material of higher resistance than the paper."

402,484. Containing Cell for Secondary Batteries. Paul Schoop, Zurich, Switzerland.

Claim 1 is as follows: "The rectangular cell body for secondary batteries provided on its inner sides and bottom with parallel-notched side racks and parallel upwardly-extending bottom racks."

402,491. Magnetic Pocketbook. Benjamin F. Thomas, Denver, Col.

The pocketbook is provided with a flap, and a magnet is secured in the flap.

402,506. Electric Signal. John T. Carter, Baltimore, Md., assignor of one-half to Frank J. Hilbert, same place.

402,507. Duplex Fire Alarm Telegraph. Sidney A. Chase, Hart, Mich.

Of the ten claims the fourth is given: "4. In a system of fire alarm signals or telegraphs, a duplex signal transmitter consisting of a central metallic disk and two independent signal disks having the same characteristic signal on each disk, but located at points diametrically opposite each other, in combination with contact springs, and circuit connections, whereby the same signal may be sent twice in one revolution of the signal wheel."

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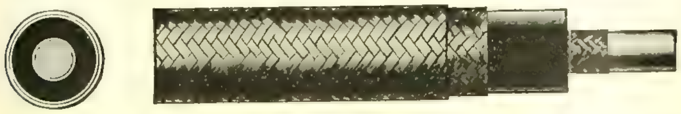

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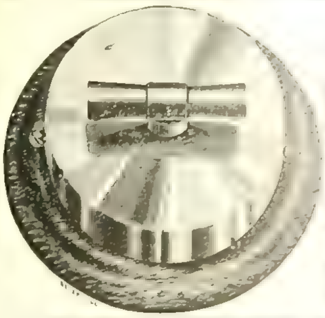

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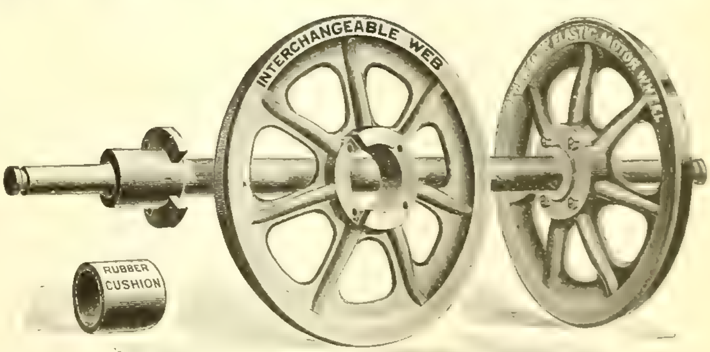

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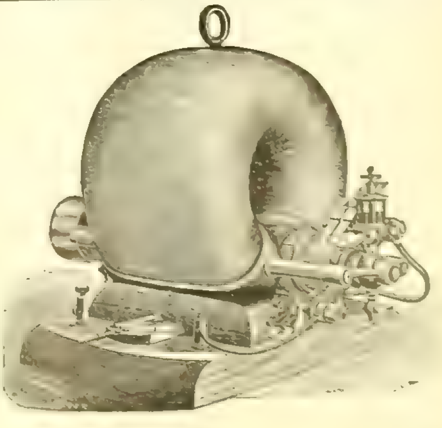

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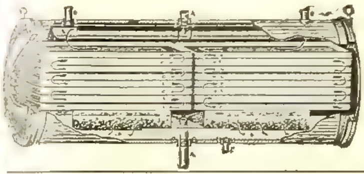

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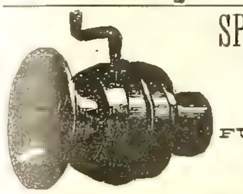

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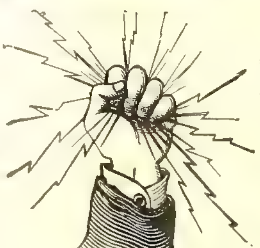

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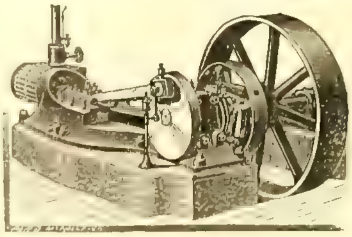

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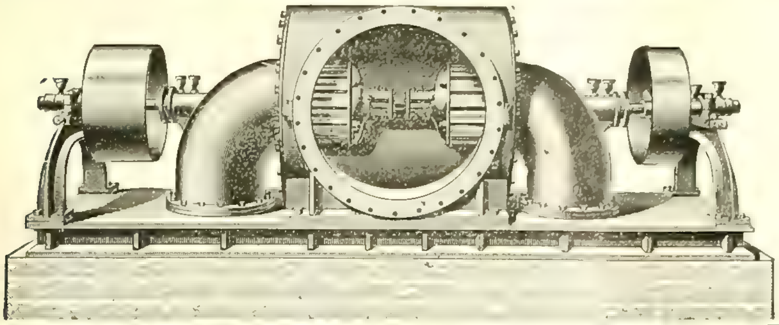

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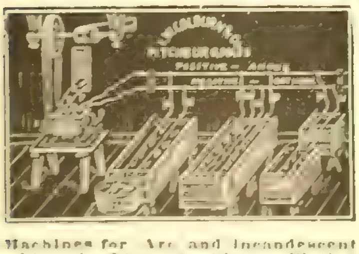

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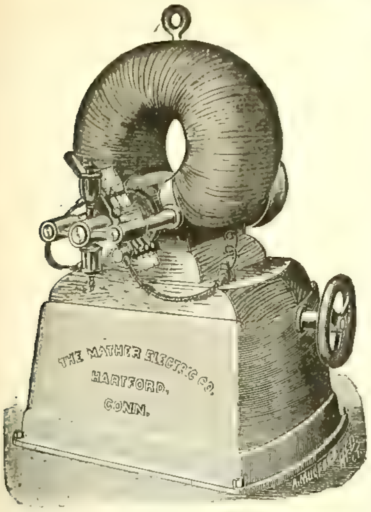

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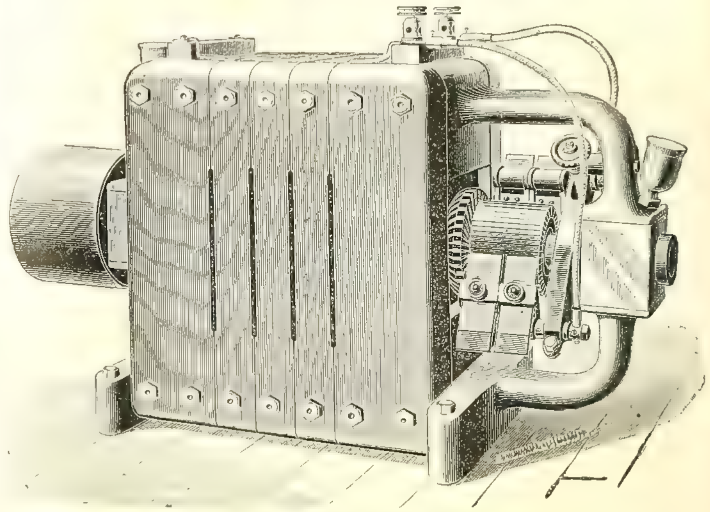

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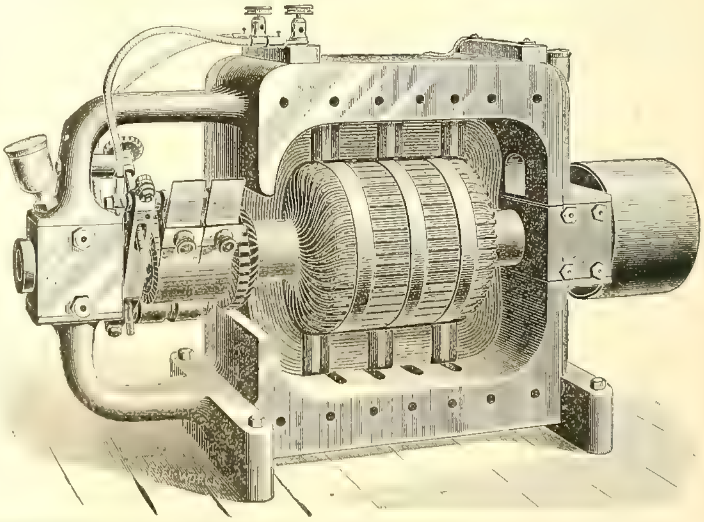

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Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simple a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

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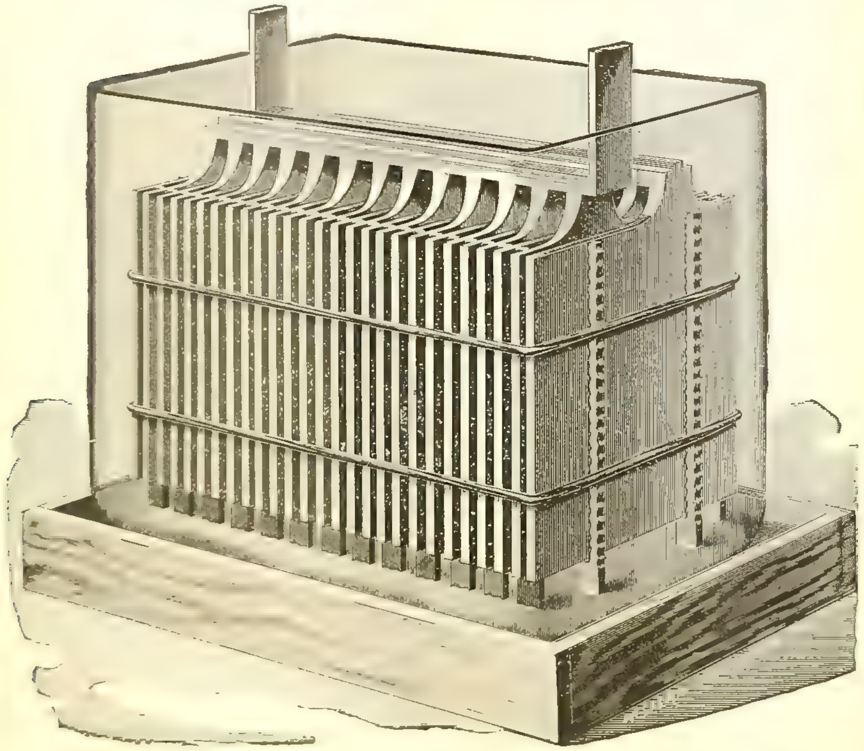

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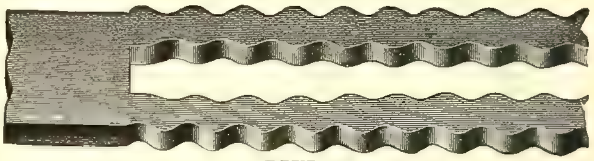

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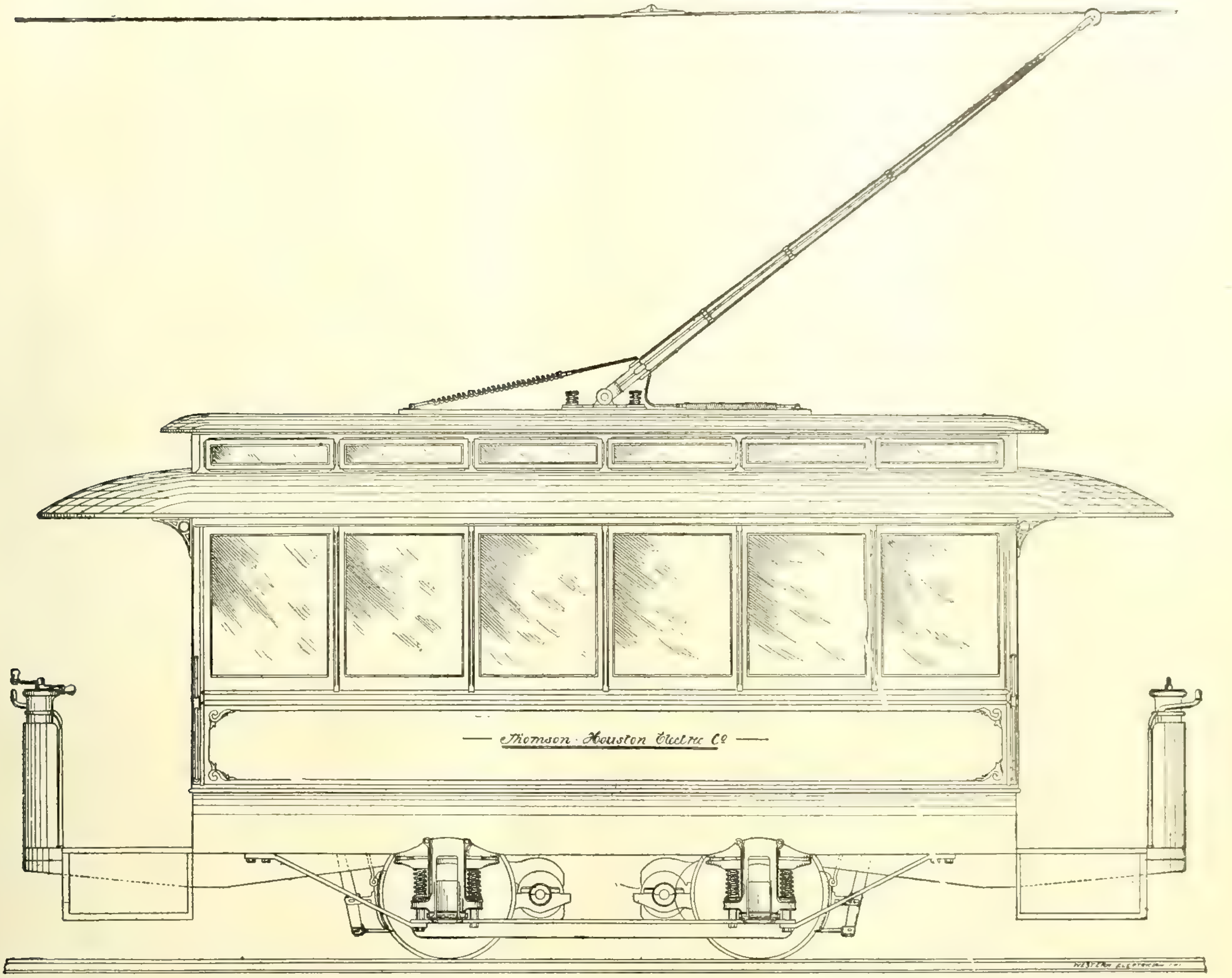

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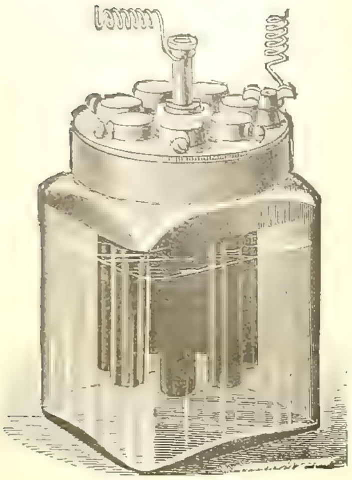

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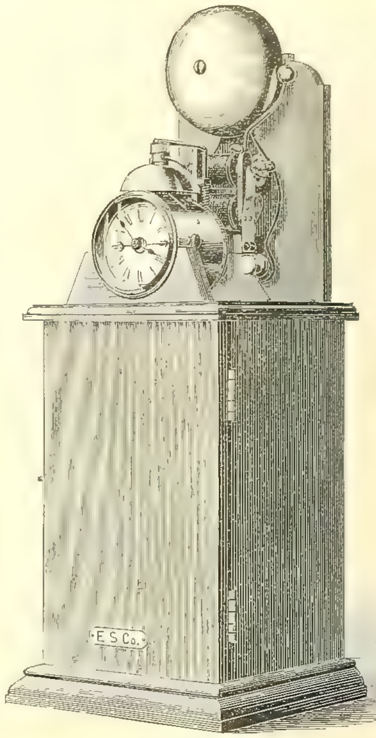

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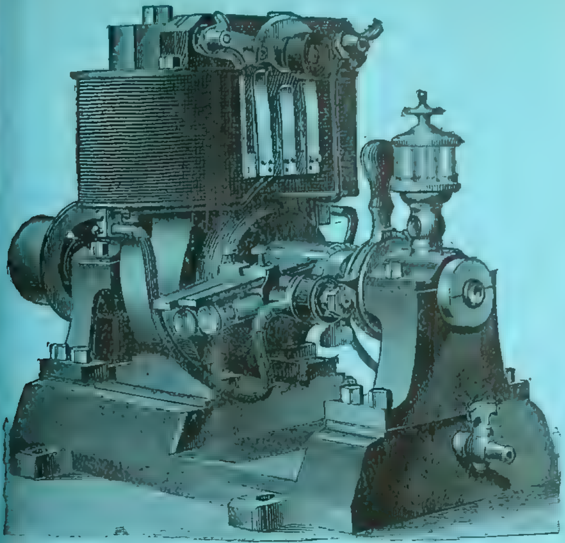

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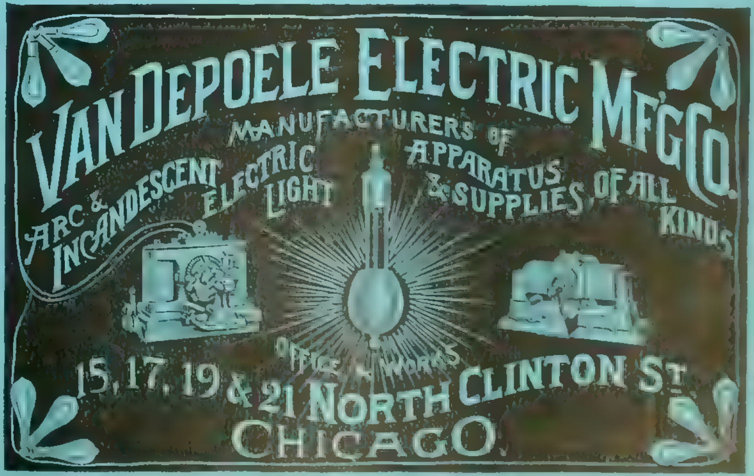

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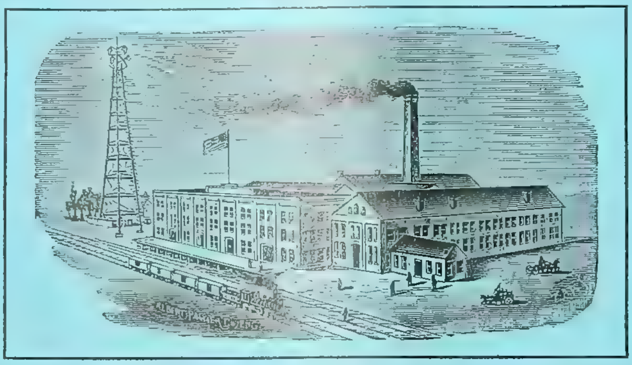

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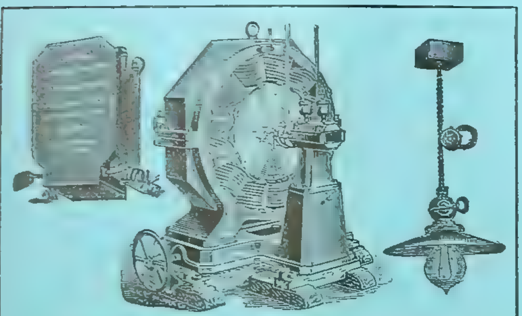

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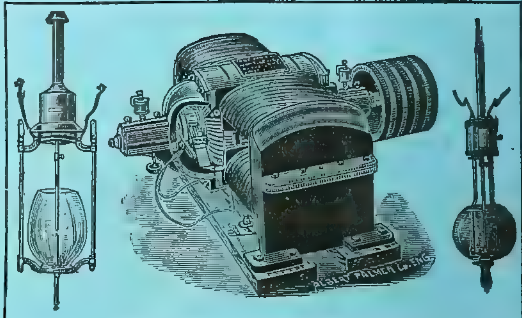

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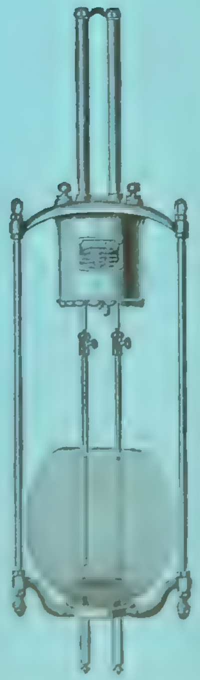

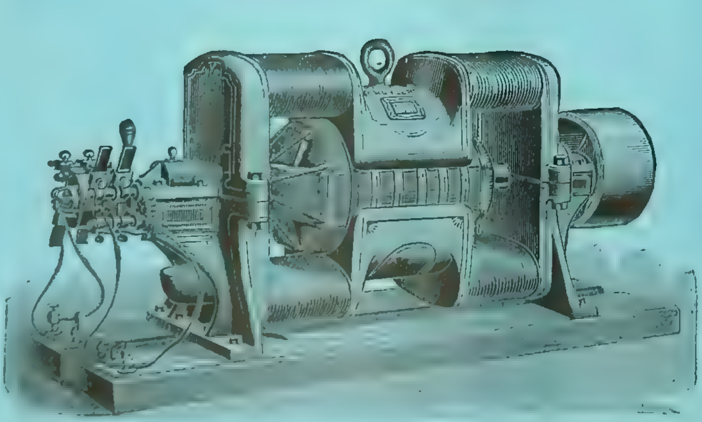

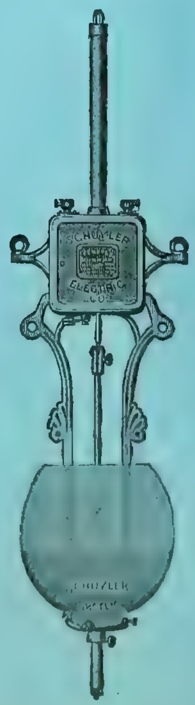

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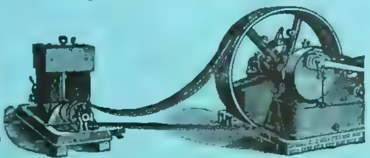

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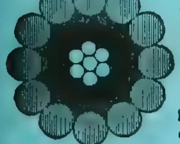

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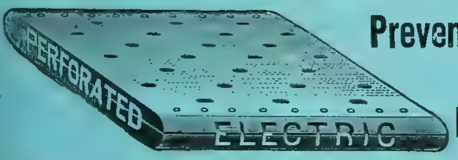

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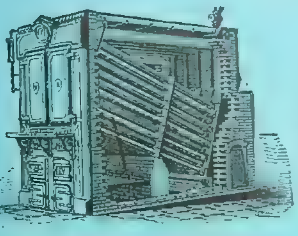

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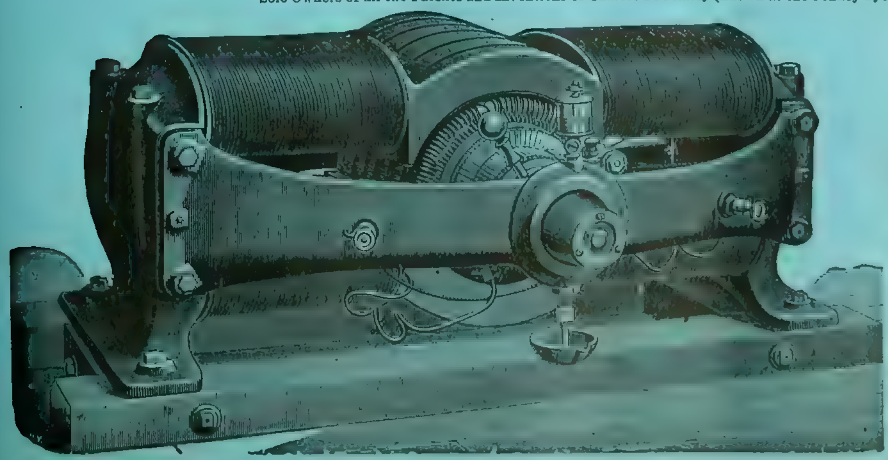

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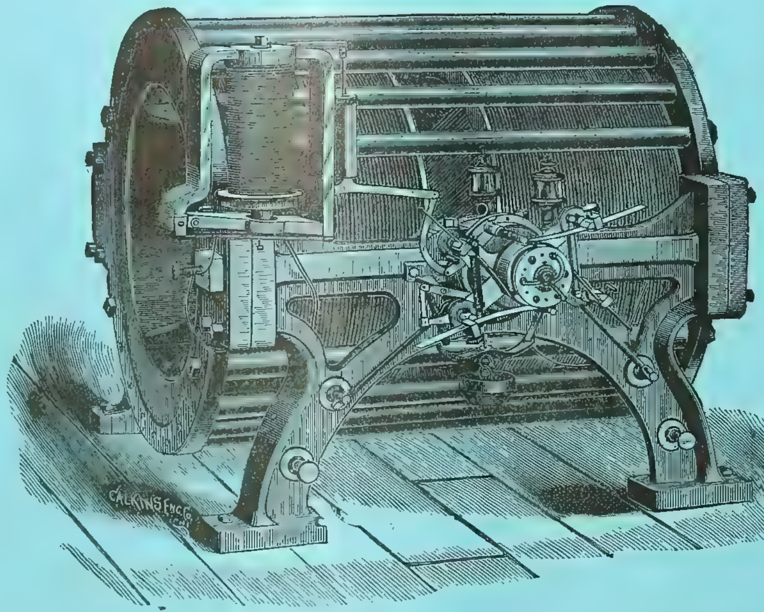

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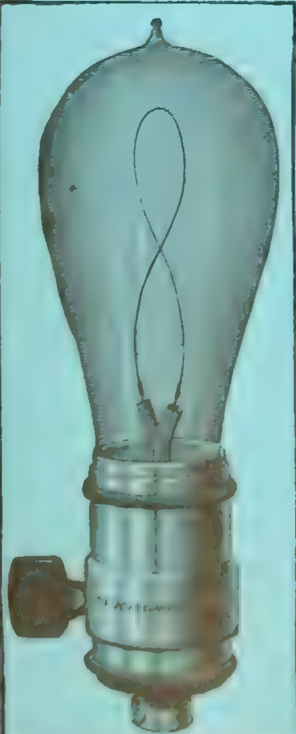

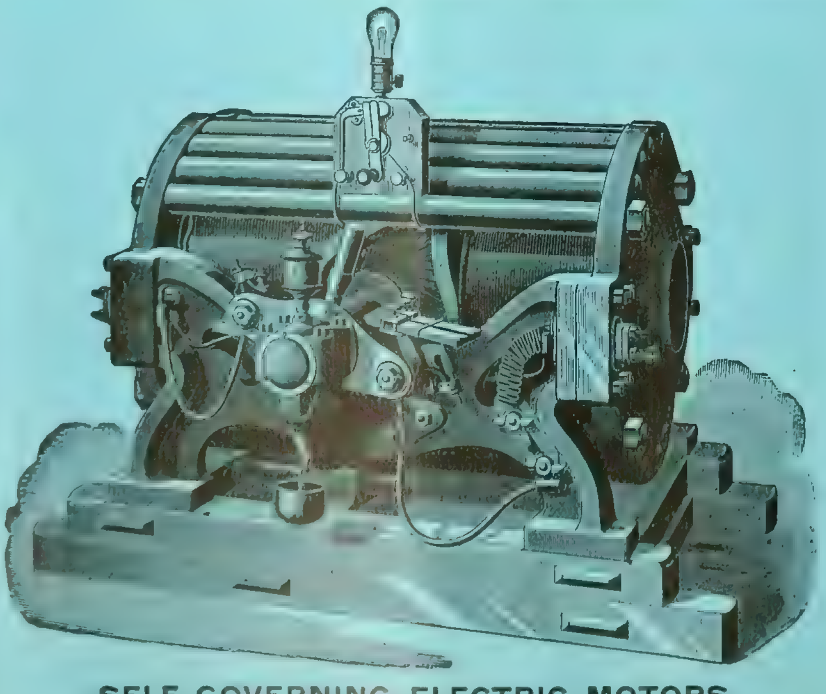

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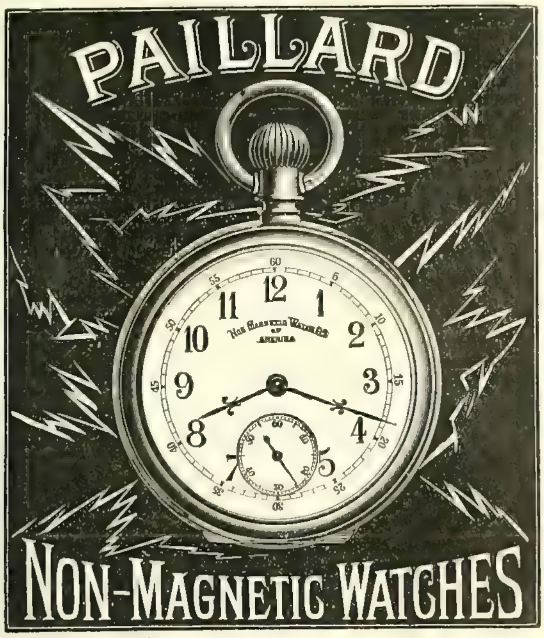

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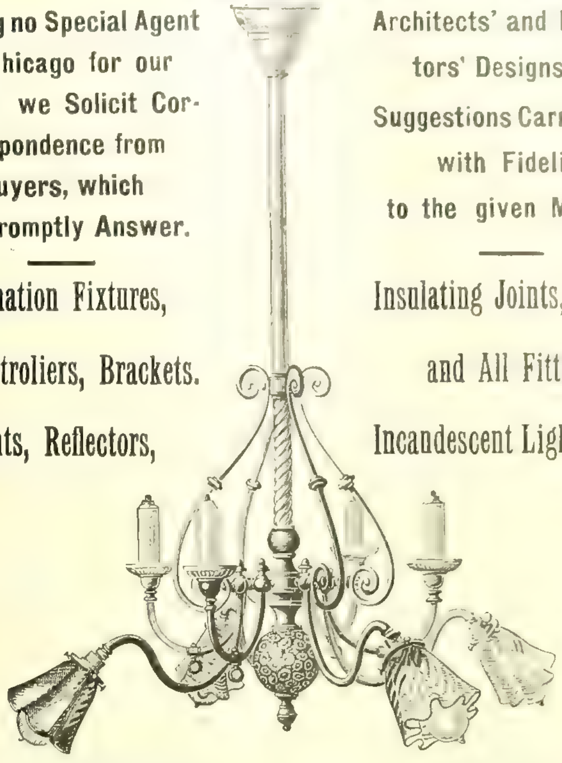

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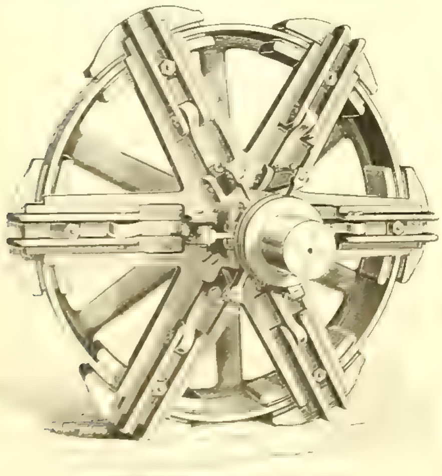

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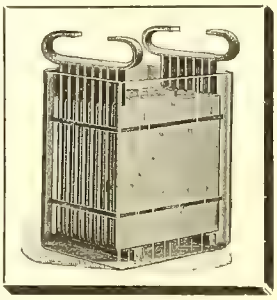

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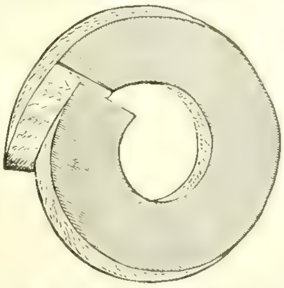

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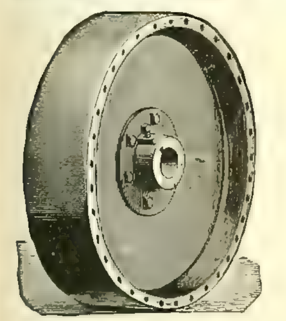

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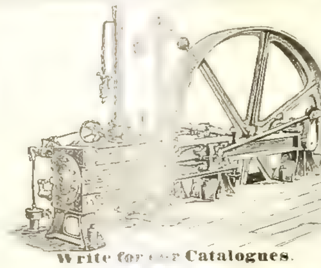

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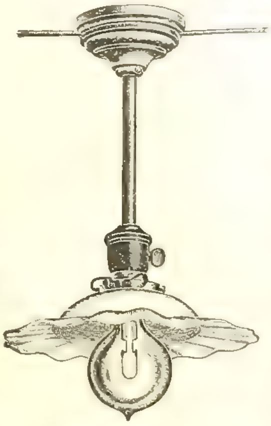

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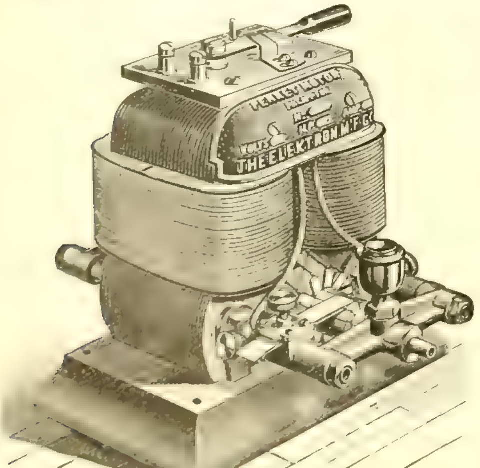

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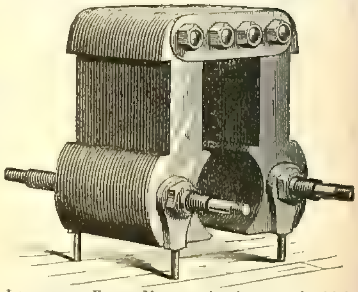

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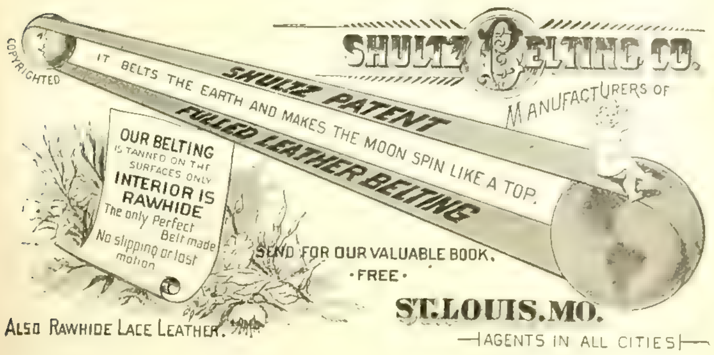

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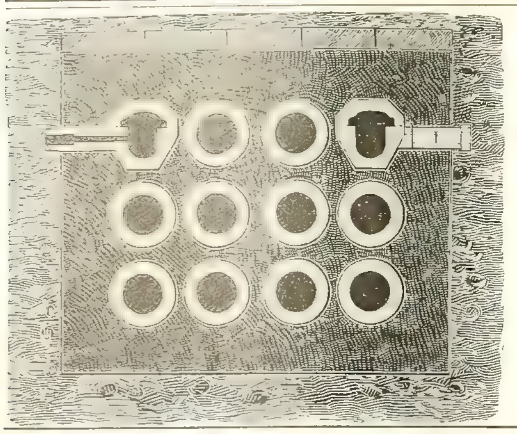

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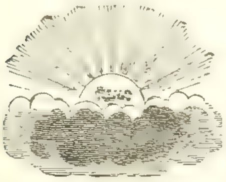

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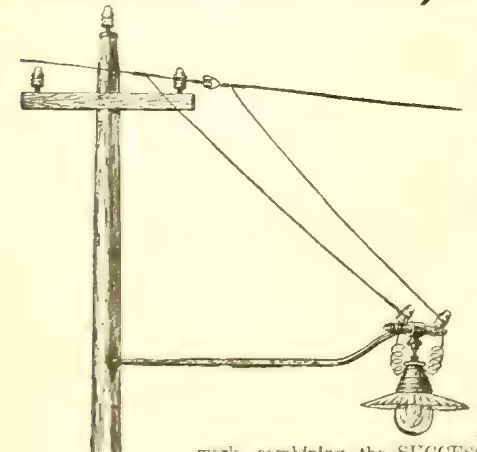

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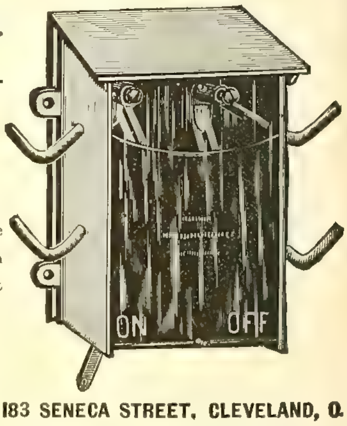

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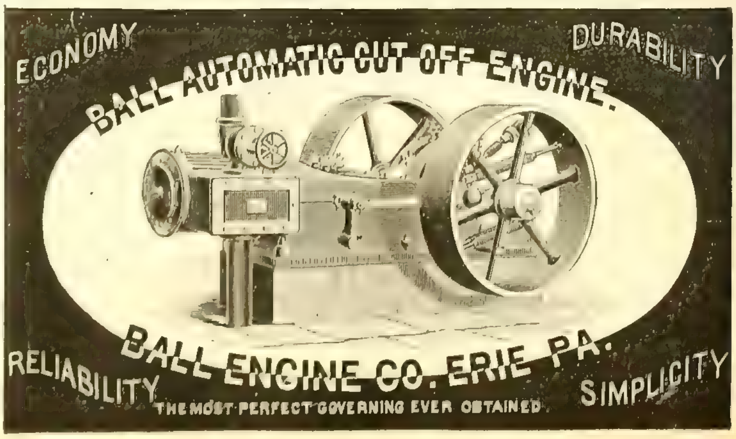

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In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor ?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

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Vol. IV. CHICAGO, MAY 18, 1889. No. 20

Accumulator Installation in a Chicago Residence.

One of the most familiar questions to those engaged in the accumulator business is this, which is asked almost every day: What is the use of the storage battery when a dynamo is required to charge it? Why not use the dynamo and run the lights direct? A practical answer to this question will be found in the plant recently installed at the residence of Potter Palmer of Chicago, by the Electrical Accumulator company. This plant, which is the first of its type in the western country, presents a number of novel features, which combine to make it almost an ideal plant for private lighting.

The generating plant is shown in Fig. 1, which represents the gas engine and dynamo. This engine is of the well-known Otto type, rated at 20 actual horse power, and running at 160 revolutions per minute. The engine drives a counter-shafting, running at the rate of 800 revolutions per minute. This counter-shafting carries a fly-wheel weighing about 1,900 pounds, which serves to steady the otherwise slightly irregular motion due to the fact that the engine does not take gas at every revolution.

The dynamo is of the United States company's make, is shunt wound, and has a capacity of from 75 to 80 amperes, and from 125 to 140 volts. The engine, counter shafting and dynamo are all mounted on substantial foundations. As the exhaust from the engine would make a slightly unpleasant noise if permitted to escape directly, it is led through three exhaust pots, or "silencers," into a 30 foot chimney, in consequence of which there is almost no sound outside the engine room.

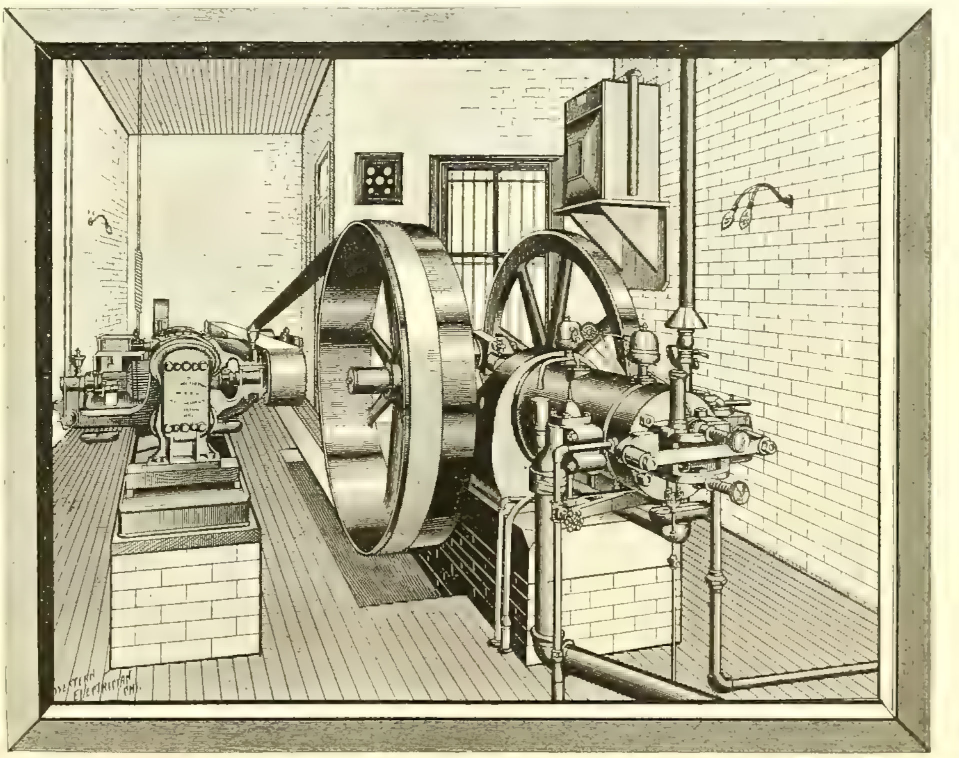


FIG. 1. ACCUMULATOR INSTALLATION IN A CHICAGO RESIDENCE.

Fig. 2 shows a general view of the battery room, containing 112 cells of the Electrical Accumulator company's "15A" type. These cells when fully charged have a normal capacity of 100 lamps for 10 hours, or 130 lamps for 6 hours. The cells are placed upon substantial shelving, the supports of which rest upon glazed tiling, and in order to still further improve the insulation, each cell stands on an insulated tray. Somewhat more space has been given to the cells than is actually required, in order to simplify the inspection of them, and to prevent any possibility of leaks by reason of moisture.

The battery room is provided with two lamps suspended by flexible cable which may be used when examining the cells. Several standard hydrometers are in use in each series, and in addition each individual cell is provided with an indicating float. By means of this the specific gravity can be determined without trouble at any time, if desired.

In Fig. 3 the switch-board is shown, upon which are grouped the various devices used in manipulating the plant. The cells are arranged in two series of 56 cells each, and are independent of each other, excepting where they are brought together at the switch-board. Each series is provided with a five-point non-break regulating switch for varying the number of cells in use, with an ammeter and a small indicator to show the direction of the current, and with a small rheostat, by means of which slight differences in the working resistances of the two series may be allowed for. Both series are provided with one common over-discharge switch, which notifies the consumer at once when he is drawing upon the battery at too heavy a rate, and the switch-board is so arranged that a number of different combinations can be made, if desired. First, the lamps may be supplied directly from the dynamo, the use of the fly wheel on the counter-shafting giving an absolute steadiness. Second, the dynamo may charge the battery and supply light at the same time. Third, one series may be charged while the other series is discharging. Fourth, the accumulators may be used when fully charged for supplying light independently of the dynamo, and fifth, the accumulators may be worked in conjunction with the dynamo when a greater number of lights is desired than either could supply alone, making the joint capacity about 250 lamps.

When the cells are being charged the voltage, of course, will rise, and, in order to compensate for this, a rheostat is placed in the lamp circuit. This, however, is used very little, as in general the charging for this particular plant is done in the daytime when but few lamps are in use. The switch-board also carries a pressure indicator connected directly to the mains in the house, and a voltmeter, which is used in throwing the dynamo onto the charging circuit. The dynamo is provided with the usual rheostat and ammeter, and also with an automatic break switch to prevent the battery from discharging into the dynamo, if its e. m. f. should fall below that of the battery for any reason. The current is conveyed from the switch-board to the house, about 200 feet distant, by means of Patterson underground cable laid in a wooden conduit, which is filled up with a mixture of pitch and sand. This same conduit brings back a pair of pressure wires to the switch-board.

The plant was completed about the middle of February, and its operation has been watched closely ever since. It has been found, except on special occasions when the maximum number of lights were required, that it was only necessary to run the dynamo two or three days a week, and the dynamo has never run at night, excepting during the first charge of the accumulators, and for one or two special evenings when a large number of lamps was required.

The capacity of this plant has been tested several times, and has been found fully equal to the work it was guaranteed to do. A record of the gas consumption has been taken ever since the plant started, and it has been found that the amount of gas used is from 3 to 3½ cubic feet per lamp per hour, which is certainly an economical gas consumption.

In a private house it is of course essential to have light available at all hours, day and night, and a moment's reflection will show that to keep a direct plant in operation twenty-four hours a day for such work as this, would be simply out of the question.

A plant such as that in Mr. Palmer's residence affords a solution of the domestic isolated plant problem, as the condition of the case demands that electricity and power should be available at all times.

When the accumulators require it, a man, at other times otherwise employed, starts up the engine and charges the cells. During the summer, while very little light is required, it will not be necessary to run more than once in two weeks.

St. Louis Telephone Company's Victory.

The Bell Telephone company of Missouri won a victory in St. Louis last week. The first case involving the validity of the contracts between the Bell Telephone company and its subscribers made pending the late test case in the Supreme court was disposed of by Judge Valliant and judgment given in favor of the telephone company. The circumstances of the case are that the Municipal Assembly fixed the telephone rates at $50 per annum, which was $5 less than the rates fixed by the company. The company declined to recognize the ordinance, and when its officers were arrested for violating its provisions they appealed to the Supreme court. A

contract, however, was entered into with such subscribers as desired to retain their telephones, to the effect that if the Supreme court declared the ordinance fixing the $50 rate invalid the subscribers would pay the old rate of $100 per annum, otherwise the company was to charge only $50. Among the subscribers who signed the contract was M. W. Doyle. He, however, afterward repudiated the arrangement, and the company sued him for $25, the amount alleged

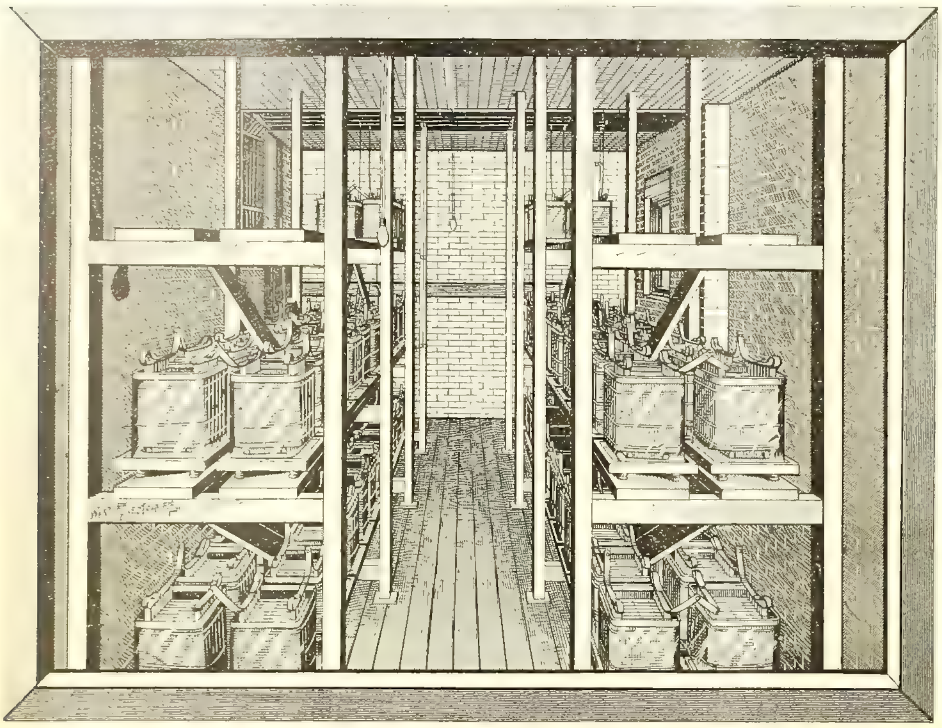


FIG. 2. ACCUMULATOR INSTALLATION IN A CHICAGO RESIDENCE.

to be due for one quarter. The trial came up before Judge Valliant. The case had not progressed far when the judge gave an instruction directing the jury to return a verdict for the plaintiff on the ground that the contract between the company and Doyle was valid, and that the Supreme court having held the ordinance fixing the rate at $50 invalid, Mr. Doyle was liable for the $100 rate. Ed Heyd, a juror, protested and refused to be governed by the court's instruction, but after the court explained to him that the only question in the case was the validity of the contract to abide the decision of the State Supreme court, he joined the other jurors in bringing in a verdict against Doyle.

Phonograph Litigation.

A bill in equity was filed in the United States Circuit court in New York city last Saturday in the suit instituted by Thomas A. Edison, Ezra T. Gilliland and John C. Tomlinson. Mr. Edison wants the court to compel his old friends and agents to make an accounting to him and reveal the facts about the negotiation of the [illegible] phonograph company and a contract [illegible] the invention.

In his bill Mr. Edison declares that he is an [illegible] gathered about him many em[illegible] ties of friendship as [illegible] have given him their [illegible] and have received his confi[illegible]. He says that it has [illegible] reward these persons by giving them stock in his inventions; and that in [illegible] Mr. Gilliland to leave the [illegible] giving him a [illegible] Gilliland pre[illegible] Tomlin[illegible] having an inconsiderable business [illegible] and made [illegible] placed him upon [illegible] friend was [illegible] Gilliland

had a contract to do this, which amounted to a monopoly of the sale of the phonographs. The bill declares that no consideration was paid by Gilliland; that no sales of phonographs were ever made by him under the contract, and that in consideration of receiving the contract he agreed to hold it subject to Edison's pleasure and absolute control, and always to make and hold his contracts of like nature subject to the same control.

Mr. Edison then states that in May of last year Gilliland and Tomlinson agreed to negotiate the sale of Edison's stock in the Phonograph company; that he, Edison, was reluctant to sell his stock, but was urged to do this by the defendants; but that finally all the stock was sold to Jesse H. Lippincott for $500,000. Then comes the pith of Mr. Edison's charges. He declares:

That during the progress of the negotiations for the sale of the said stock, and as a part thereof, the said Gilliland and Tomlinson also negotiated with the said Lippincott a sale of the said Gilliland agency contract, and included a sale of said stock; that the said negotiations for the sale of your orator's stock and said Gilliland's contract were carried on by defendants, at the same time, and the sale of both stock and contract consummated on the same day; that pending the said negotiations, the defendants informed your orator of their intention to sell the said Gilliland agency contract for the sum of $250,000 in stock in a company intended to be organized by said Lippincott for the purpose of acquiring the phonograph patent rights for the United States of America, but these defendants at the same time represented to your orator that the stock aforesaid, to be received by them under agreement for the said contract, was of uncertain value, and would not exceed, under the most favorable circumstances, a cash value of $75,000, whereas the fact is, that at the time of such representation the defendants knew the same to be untrue, and knew that they then held an additional agreement contemporaneous with the agreement between your orator and the said Lippincott, that if the sale of both said Edison phonograph stock and Gilliland contract should be successfully accomplished, he would repurchase from them, at their option, the said $250,000 of stock at par; that the defendants concealed from your orator such additional agreement with said Lippincott and your orator was not aware, at the time of [illegible] the [illegible] agreement with Lippincott that, as a part of the same transaction, the defend[illegible] the said $250,000 of stock [illegible] option to sell the same to said Lippincott [illegible] dollar for dollar that your orator [illegible] known the fact aforesaid [illegible] the agreement aforesaid.

Appended to the bill is a copy of the contract of Gilliland as general agent, whereby Gilliland is appointed sole agent. The respective rates of profit are fixed. On each phonograph the Edison company is to have 20 per cent. of the cost as royalty, and on the total sum thus obtained the company is to have 35 per cent. profit. The difference between that and the price charged the public is to be allowed to Gilliland for expenses; and 15 per cent. of the cost of the phonographs to Gilliland is to be allowed to him as personal compensation. The selling price to the public is to be mutually agreed upon by Gilliland and the company; and Gilliland promises to buy from the company and to sell each year a certain number of the phonographs, this number to be agreed upon by arbitration, if necessary. Any way, every year for five years from the beginning of Gilliland's agency the number of phonographs he must sell must be increased 10 per cent.

Mr. Tomlinson was interviewed concerning the suit, and made the following statement: "We deny all the first part of these allegations in toto. In a word, we deny that we are Mr. Edison's beneficiaries. Our connection with Mr. Edison has resulted in a financial loss to both of us. Mr. Edison got Mr. Gilliland to come to his side when Edison was insolvent. Mr. Gilliland was a capitalist, and he put hundreds of thousands of dollars at Mr. Edison's service. He was not, in any way, Mr. Edison's puppet in the contract business, as Mr. Edison says, but there independently, doing business for himself. He gave Mr. Edison patents, which he controlled. But doesn't it strike you that Mr. Edison's complaint is a very singular one? Now, we deny absolutely that we ever told Mr. Edison that our contract was only worth $75,000. We sold it for $250,000 in the Lippincott stock, and resold this stock to Lippincott at par, as we had a right to. But think of Mr. Edison stating in his own complaint that he sold his stock for $500,000, when he believed that it was worth but a very small part of that. Now if you take the trouble to figure up the percentages in the agency contract, you will see that for every $12 of profit to the company, Mr. Gilliland got $7. That is what it amounts

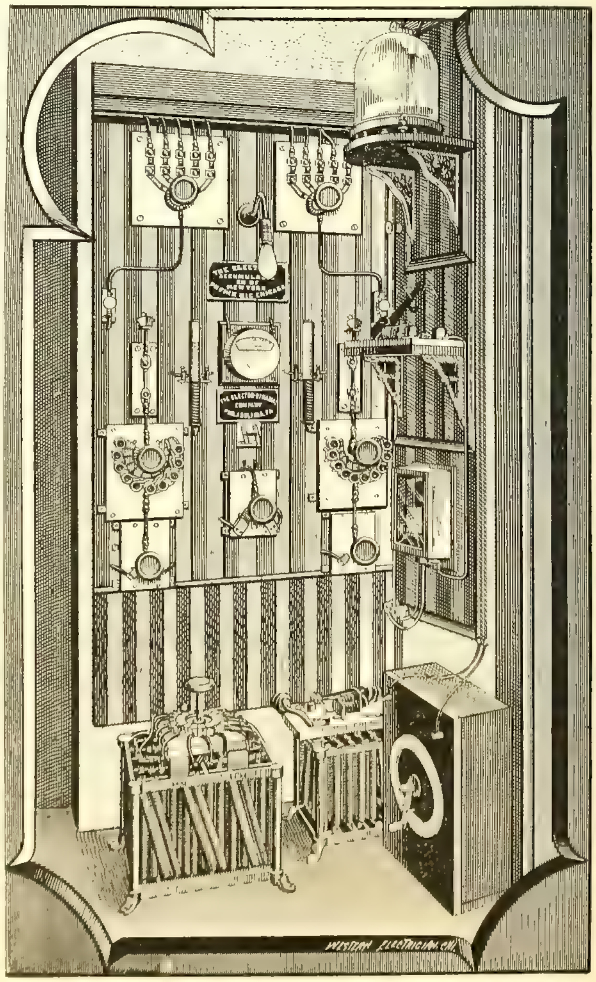


FIG. 3. ACCUMULATOR INSTALLATION IN A CHICAGO RESIDENCE.

to. We sold in nearly the same ratio $500,000 and $250,000."

The Maquaire Arc Lamp.

At a recent meeting of the London Society of Arts the Maquaire Alpha arc lamp was exhibited for the first time. The characteristic features of the lamp are shown in the accompanying cuts. The feeding of carbons in the lamp is actuated by the motion of a small reversing electric

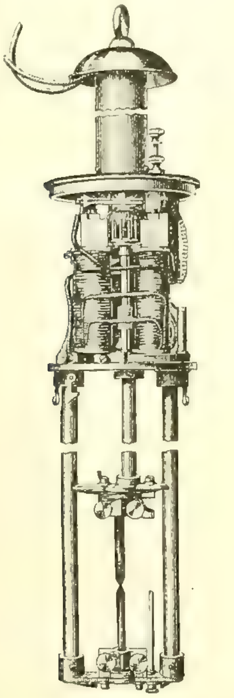


FIG. 1. MAQUAIRE ARC LAMP.

motor in the mechanism. The following description is taken from the London *Electrical Engineer*:

Both the detent action and the mechanical motion of feed are controlled electrically, and the feeding is thus directly dependent on the needs of the lamps, the carbons being fed by imperceptible movements, and only when the

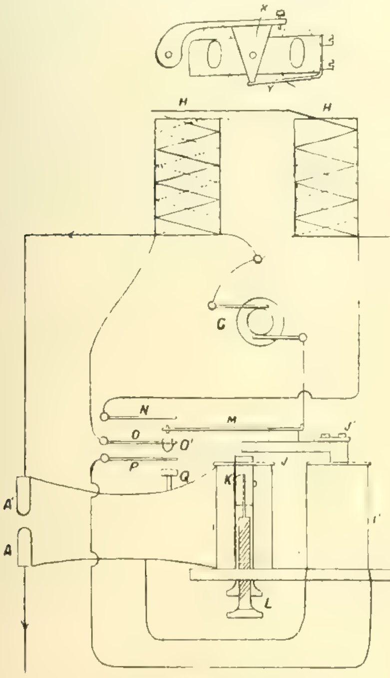


FIG. 3. MAQUAIRE ARC LAMP.

electrical requirements of the arc itself need the feeding. Fig. 1 illustrates the Alpha arc lamp with casing removed, showing the small electro-motor and brushes. Fig. 2 shows the regulating mechanism. Fig. 3 is a diagram of the connections.

To understand exactly the action of the lamp, we may follow the course of the current through the mechanism. First of all, it may be stated that there is a worm on the motor shaft, gearing to the rod which carries the upper carbon. When the motor turns one way, therefore, the carbon is lowered, and it is raised if the motor is reversed; this action is, moreover, of considerable force, requiring a strong effort to stop it by the hand, and such minor obstructions as a little dirt, rust, or roughness, often so troublesome in lamps actuated by gravity, are of very little consequence when there is the force of the dynamo itself behind the motor.

The coils, it has been suggested, may be divided into "brains" and "muscles." The coil I is a shunt across the arc, and acts as the brains or directive force, without itself doing the work. The field magnets and armature of the electro motor are the muscles which, under direction of the brains, move the carbons. On entering the lamp the current first traverses the series coils of the electric motor, then going to the upper carbon and across the arc to the lower carbon, and so back to the main wire. At the carbons, however, a shunt wire leads to the contact, Q, and to the shunt coil, I. The little motor is wound so that its armature is a shunt to the field magnet, but is so arranged that it is a shunt to either the coil H or the coil H' according to the contact made by the vibrating arm, M.

The shunt wire is shown in the diagram by dotted lines. The wire of this shunt circuit is bared at the crossing between the coils, and is connected at this point to the brush, G, of the armature of the little motor; the other brush being connected to the vibrating contact, M, which, under action of the coil, can connect either with N upward or O downward. O' is an insulating stud. The pull of the coil I upon J is regulated by a screw, L, acting upon the core of this coil.

It will be easily seen that when the coil I acts upon the piece of iron, J, the shunt current is sent through the armature of the motor in one direction, while if it releases it, letting M touch at N, the current will be in the reverse direction. In any electric motor, to reverse the current in the armature, while the current in the field remains the same, is to reverse the rotation of the motor, and this action of the coil I upon the vibrating contact M keeps the motor almost constantly in motion one way or the other. When the arc becomes long its resistance increases, and more current goes through the shunt coil, I; this moves lever M, sending a slight current through the motor armature, which feeds the carbons downward by almost imperceptible motions. Should the arc from any cause increase to too great an extent, the shunt coil pulls strongly on the lever, M, causing it to press together, by means of the insulating stud, O', the contact points P, Q; this short-circuits the arc through the other coil I', thereby increasing the pull on the lever, and insuring good contact between P and Q.

The lamp may be made to strike any desired length of arc and feed at any potential by altering the position of the contacts N and O. The potential on the armature of the motor is two volts.

The arrangement for starting the lamp and striking the arc are shown in a plan at the top of the diagram, and can also be seen at the base of the lamp in the other illustration. The lower extremity of the armature shaft is pivoted at its lower end in a movable V-shaped yoke, X. This, when the lamp is working, is attracted by the field magnets completing their magnetic circuit, and at the same time throwing the worm into gear with the wheel, which raises the carbons and strikes the arc. When the lamp is not working the movable yoke is pushed back by a spring, Y; the worm being thus released from the wheel, the rack falls, and the carbons come together.

The burning of these lamps is extremely regular; it is hardly too much to say that not the slightest flicker is ever noticeable to the eye.

Lamps of this description have been burning for some time past in Kensington High street, near the Albert hall, run two in series on the 100 volt incandescent circuit, and have given every satisfaction; and it is understood that there are some hundreds of them in the Paris exhibition.

The Duluth Electric Light & Power company of Duluth, Minn., has increased the paid-in capital from $[illegible] to $75,000. The capital is now $200,000, and it is stated that extensions of the arc and incandescent system will before long absorb the entire authorized capital.

Electrical Course in Columbia College.

[illegible]

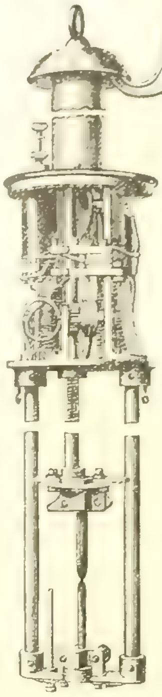


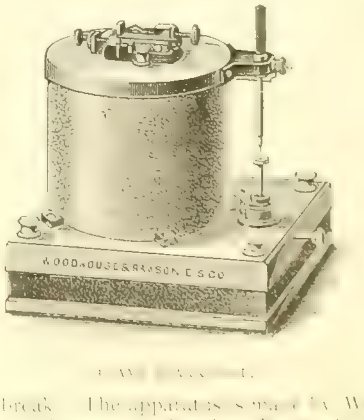
FIG. 2. MAQUAIRE ARC LAMP.

college on F. B. Crocker and Michael Pupier, respectively. That the college has excellent ground for its selection is beyond question. Mr. Crocker's work in the past is so well known as hardly to need recall. Perhaps nothing has done more to establish Mr. Crocker's reputation as a clear and earnest thinker on, and a skillful, practical adopter of, the principles of electricity than his paper read before the American Institute of Electrical Engineers, at its annual meeting last year, on "Chemical Generators of Electricity," which elicited the admiration of that body. The latest tribute to Mr. Crocker's standing and attainments by the profession is his election as president of the New York Electrical Society.

Mr. Pupier, who co-operates with Mr. Crocker, has the advantage of a brilliant record, and is highly spoken of as a mathematician. He has secured the Tyndall Fellowship, while holding which he worked in Helmholtz in Berlin. The college has taken to itself an important and enviable mission, and has the unanimous good wishes of the electrical profession.

Flame Spark Coil.

The accompanying cut shows Pyke & Barnett's flame spark coil with continuous action.



FLAME SPARK COIL.

rapid break. The apparatus is made by Woodhouse & Rawson of London, England. The form which is shown in the cut is an improvement on the earlier design. [illegible] and the moving parts of the break, which [illegible] the recessed center of the [illegible]

the top board, for ready adjustment. The break is quite a new departure, and from its certainty of action forms, perhaps, the most valuable improvement in these coils. The principle of its action is as follows: A hammer, mounted on a short, thick spring, is very rapidly and vigorously vibrated by means of an electro-magnet included in a shunt circuit, and the main or coil contacts are so arranged that—one [illegible] mounted on a spring—on the re[illegible] of the vibrating hammer it strikes against the movable main contact, and causes a slight and instant separation. The whole of the parts are arranged for ready and rapid adjustment, and the flat contacts are arranged on screws which are readily removable for replatinizing. The arrangement of the dischargers is also very neat, and not so liable to damage as the old style. The size of the coil, No. 1, is five inches in diameter by 4⅝ inches high.

The Electric Motor—How it Moves.

BY FRANK L. PERRY.

To the more learned of the electrical fraternity it might seem presumptuous to hint that at

FIG. 1. THE ELECTRIC MOTOR.

this late day there are many persons actively engaged in the various branches of the electric motor business, who do not know how the armature of the machine is put in motion by the action of the current. The steam engine with its many and complicated parts, doubtless, is readily understood and explained, but the little motor with its one moving part—in how many cases does it seem to be a mystery? The fear of the "x—y's," "x+y's," "lines of force," etc., which enter so largely into current electrical literature, or the popular conviction that the theory of electrical machinery can only be understood by those specially educated—perhaps

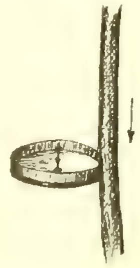


FIG. 2. THE ELECTRIC MOTOR.

these tend to discourage many from making the attempt. The object of the writer is not to go deeply into the theory of the machine, but mere[illegible] the simplicity of its working, and [illegible]st a few simple experiments which may [illegible] wish to know just how [illegible] made to revolve.

In [illegible], Prof. Jean Christian [illegible] performed, before a class [illegible] which clearly demon[illegible] relation between [illegible]. The experiment was [illegible] of electricity [illegible] through a wire held above and par[illegible]. On the pas[illegible] itself [illegible] on at right angles to the [illegible]

Fig. 1, pointing to the north and at the wire. If the current be passing through the wire, the needle will set itself either as in Fig. 2 or as in Fig. 3. Should the north pole of the needle move off to the *left* of the wire, Fig. 2, the direction of the current through the wire is as shown by the arrow. If it should move in the other direction—to the *right*—the flow of current is as the arrow in Fig. 3 indicates. These simple facts show us that where a magnet pole and a wire carrying an electric current are brought near to each other, with some mysterious force they act one upon the other. This influence, or what might be described as the push and pull or pull and push of a magnet pole upon a wire carrying the current, is made use of in the electric motor. Every electric motor consists of two essential parts—an armature *A*, Fig. 4, and a field magnet *M*. The armature we may look upon as a cylinder arranged so as to revolve freely upon its axis, and having insulated wire wound around it, each turn parallel to the axis *X*, and so connected that the current delivered from the brushes *B* will be caused to circulate by the commutator *C*, through the armature wires always in the manner as shown by the arrow heads.

The field magnet of the commercial motor is simply an electro-magnet, or, in other words, it is a magnet made by the current circulating through the coils of wire wound about it. For the sake of simplicity we will, therefore, consider the motor as in Fig. 4—that is, built with a permanent field magnet, and the electric current, therefore, circulating only through the armature. Returning to our experiment with the compass, we note that when the current is flowing *down* the wire, the *north pole* of the needle sets itself off to the *left*, and when flowing *up*, it sets itself to the *right*. Now, if in the first case, instead of the magnet pole being free to move, the wire was, we would see that the wire would move to the *right*, although the relative positions of the magnet and wire would remain unchanged—for the magnet pole would still be to the *left*. Keeping these facts in mind, and also that the action of a south-pole on the wire is the reverse of that of a north-pole, we turn to Fig. 4 and note the polarity of each field and the direction of current through the armature wires. We can now readily see how the N pole of the magnet would force the wires on that side up in the direction indicated, and how the S pole would likewise force down past its face the wires on the left hand half of the cylinder. As the wires are secured by bands to the cylinder or body of the armature and the commutator, as explained above, so connected to the armature and arranged in regard to the brushes that the current is readjusted, as it were, in its circulation every time the armature is pulled far enough around to bring a new segment of the commutator under the brushes—a continuous rotation is produced.

While many forms of motors will be of a different shape and seem, perhaps, more complicated than the one illustrated, the reader will find that a thorough understanding of the relation which the two essential parts, the armature and field magnet, bear one to the other, how the fields act upon the armature, etc., will enable him, with little difficulty, to understand how any electric motor moves.

State and Municipal Legislation.

A. R. Foote, chairman of the committee on state and municipal legislation of the National Electric Light association, has been actively engaged in organizing the work since the February convention. The following circular from Mr. Foote tells of the progress which has been made:

The resolution creating this committee was adopted so near the close of the Chicago convention, that little opportunity was afforded in which to make up its membership, or mark out its course of action. The first problem has been how to secure a committee of able men identified with operating companies, each of whom would represent his state in whatever way might become desirable in giving effect to the plans of the committee.

To secure the best results and to avoid misunderstandings, I printed a list of all names proposed and sent two copies to the officers and the executive committee of the association, with the request that they would retain one copy for their information, and return the other with their suggestion. It became quickly apparent that some persons were not members of the association whom it would be very desirable to have associated on the committee. In view of this, it was thought best to nominate such persons, and invite them to become members of the association at the time they were informed of their nomination as a member of the committee for their state. As soon as a majority of the lists were returned, a new list was prepared and sent to the same persons. When a majority of the second lists were returned, a third list was prepared for the information of the persons nominated. It is as follows:

FIG. 3. THE ELECTRIC MOTOR.

1. Alabama—Wm. Gesner, Montgomery.
2. Arkansas—Dean Adams, Little Rock.
3. California—Geo. H. Roe, San Francisco, 227 Stephenson street.
4. Colorado—C. H. Smith, Denver.
5. Connecticut—J. C. English, Bridgeport.
6. Dakota—Judge Stone, Fargo.
7. Delaware—C. Newbold Trump, Wilmington, 50 West Third street.
8. Florida—G. Stuart Smith St. Augustine.
9. Georgia—Judge H E. W. Palmer, Atlanta.
10. Illinois—S. L. Nelson, Champaign.
11. Indiana—J. B. Caren, Indianapolis
12. Iowa—Thomas Officer, Council Bluffs.
13. Kansas—M. Beebe, Hutchinson.
14. Kentucky—A. H. Barrett, Louisville.
15. Louisiana—M. J. Hart, New Orleans.
16. Maine—Geo. Westcott, Portland.
17. Maryland—Arthur J Steuart, Baltimore, 213 East German street.
18. Massachusetts—F. A. Gilbert, Boston, 17 State street.
19. Michigan—J. E. Lockwood, Detroit.
20. Minnesota—S. S Leonard, Minneapolis.
21. Mississippi—H. P. Hawkins, Greenville.
22. Missouri—J. A. Corby, St. Joseph.
23. Nebraska—Rigan, Omaha.

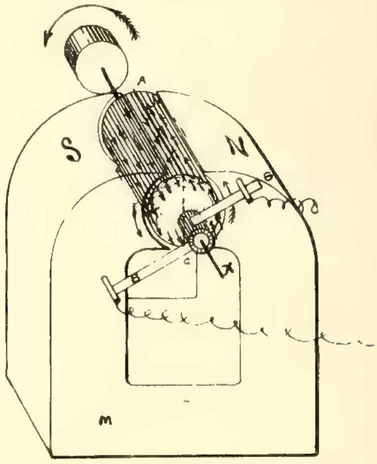


FIG. 4. THE ELECTRIC MOTOR.

24. Nevada.
25. New Hampshire—Alonzo Elliott, Manchester.
26. New Jersey—Wm. H. Moore, Plainfield.
27. New York—E. A. Maher, Albany.
28. North Carolina—D. A. Tompkins, Charlotte.
29. Ohio—A. R. Foote, Cincinnati.
30. Oregon—P. F. Morey, Portland.
31. Pennsylvania—A. J. De Camp, Philadelphia, 123 South Eleventh street.
32. Rhode Island—M. J. Perry, Providence.
33. South Carolina—Geo. B. Edwards, Charleston.
34. Tennessee—Robert L. Morris, Nashville.
35. Texas—David Hall, Galveston.
36. Vermont—M. J. Francisco, Rutland.
37. Virginia—Maurice B. Flynn, Richmond.
38. West Virginia—Jno. B. Garden, Wheeling.
39. Wisconsin—Henry C. Payne, Milwaukee.
40. Washington, D. C.—Geo. Truesdale.
41. Washington Territory—John H. Houghton, Tacoma.

This history shows that the necessary thing now to be done is for all who are interested in the association, especially those who nominated

the persons named, to use the full strength of their influence to secure their acceptance of the appointment, and thus complete the organization of the committee. While desiring most earnestly to secure this end, the fact should not be lost sight of, that it is better to have a vacancy, than a name that represents only an address on which time and money must be expended, without securing any yield of co-operative action.

In order that the nominees for the committee may be advised as to the course the committee will be expected to pursue, I prepared the following:

PLAN OF WORK.

1. An examination will be made of the laws in each state to see in what particulars, if any, the electrical industry can be benefited by securing any practical change in such laws.

2. All bills, affecting in any way the interests of the electrical industry, that were introduced at the last session of the legislature of any state, but which did not become laws, will be examined to ascertain the tendency of legislation and to see if it is desirable that they should be passed.

3. Whenever any legislation is desired in any state, or if legislation is proposed that is not desired, copies of the bill proposed will be furnished to the chairman of the committee. He will then furnish the member of the committee for that state such data, arguments and citations as he may be able to provide, to enable said memb r to place information in the hands of proper persons through whom the desired result may be secured.

4. All work done in one state will be kept in printed form, so that it can be used at once in any other state. The work will thus become accumulative, and of such a thorough character as to be practically irresistible.

5. No legislative measure or economic principle will be advocated in any manner in the name of the committee without the approval of a majority of the whole number of its members, nor will the committee undertake to secure legislation in any state without the approval of the member for that state, and then only when sufficient preparation has been made to render success a reasonable certainty.

6. Each member of the committee will recommend to the chairman an attorney for his state, who will receive and preserve for reference copies of all documents published or approved by the committee, to the end that if at any time it becomes necessary to employ counsel in that state, or if any special interest requires such service, said attorney will have the desired information, and can represent the committee, or such special interest as may wish to employ him, and have at his command much of the data necessary to familiarize himself with the subject.

7. All other considerations being equal, an attorney residing at the capital of the state will be preferable.

8. The funds of the association are not to be used for any of the expenses of this committee in any manner whatever.

Printed copies of the above were submitted to the officers and executive committee of the association, and with them copies of the letters to be used in inviting the persons nominated to accept the appointment as a member of the committee.

In this manner the time, since the adjournment of the convention, has been occupied in forming the committee and giving shape to an agreed basis for its work. No argument is required to prove that the results which this committee may achieve will be of great value to all who are interested in any way in the electric industry. It ought to be as readily understood, that the principal limitation upon its influence and usefulness will be fixed by the manner in which those co-operate with and sustain it, whose interest it is designed to serve. None who fail to co-operate with this committee should ever afterward be surprised if their isolated efforts prove ineffectual to defeat or change undesirable, or to obtain desirable, state or municipal legislation.

The Telephone Exchange at Grand Rapids.

The new telephone exchange at Grand Rapids has just been completed by the Telephone & Telegraph Construction company of Detroit, and the company has just moved to its new quarters. The operating room, of which a view is herewith presented, is on the sixth floor of the new Blodgett block; and as it was designed especially for the company, it is complete in all its details.

TELEPHONE EXCHANGE AT GRAND RAPIDS.

The room is 32 by 80 feet, and is reached by both passenger and freight elevators, the latter going clear to the cupola, the northern attic of which will be used for storage purposes. Between the rear entrance of the operating room and the hall is a ladies' cloakroom, and back of this apartment is the wire room in which are the cross-connecting boards and other necessary equipment.

The switch-board, manufactured by the Detroit Electrical works, is a splendid piece of workmanship. It is 69 feet 10 inches long, 6 feet high, and is wired for 1,500 subscribers, but its entire capacity is 2,400. About 15,000 feet of 50 conductor aerial cable has been used in the transfer and re-running of lines. The transfer from the old to the new office was unattended with any mishap or friction. In fact, so perfect was the service that the subscribers did not know the change had taken place. The cost of the new system is in the neighborhood of $20,000. Although the service at Grand Rapids has always been of the best, as is attested by the continued growth of the business, the new equipment will, it is expected, make it as near perfection as it is possible to attain.

Chicago Electric Club.

[illegible] of this policy, every resignation not heretofore [illegible] and formally accepted by letter or referred b[illegible] to the committee for further information. Fifteen new members were elected [illegible] as follows: F. H. Soden, J. Scribner, C. Cavaroc, Jr., Milton Thomas, J. W. [illegible] Ferguson, C. D. Haskins, T. P. Conant, W. H. Wissing, James Malia, W. H. M[illegible], [illegible]well, E. P. Meaney, Wm. Alcorn, A. R. Swift.

The meeting was enthusiastic throughout. Plans were brought forward for increasing the membership of the club, and the cheering news was received that the telegraph people, who have not been closely identified with the club heretofore, were now preparing to come in in large numbers, Col. Clowry having not only subscribed one hundred dollars to help furnish the new rooms, but promised to use his influence in the direction of increasing the membership from the telegraph fraternity. Similar information was received regarding the telephone fraternity, and the prospect for a large immediate increase in the membership was shown to be very good. It was decided that hereafter all applications for membership be accompanied by the initiation fee. It was also resolved that the entertainment and banquet dedicating the new room be held about June 1st, and that a large number of invitations be issued for that occasion. Tickets to the banquet will be free.

The rooms of the Chicago Electric club may hereafter be considered the headquarters of the electrical fraternity of Chicago. They are conveniently situated, handsomely furnished, and compare favorably with any similar organization in the country. The club will be served by the best caterer in Chicago, and all the other arrangements have been made on the same scale. Since the new quarters were secured the prospects for increased membership have improved, and members of every department of electrical development have become interested in the organization. The future certainly looks bright, and under the guidance of the present faithful and efficient officers there is every reason to anticipate greater success in the future than has been enjoyed in the past.

The Copper Market.

It is now generally conceded that the American representatives of the owners of copper mines were unable to reach a satisfactory agreement with the French capitalists before leaving Paris. Advices from London intimate that foreign financiers are beginning to realize that a great mistake was made by the Frenchmen in refusing to yield to the Americans. European capitalists begin to see that in all large financial matters this country is destined to play an important part in the future, and they are consequently disturbed over the result of the conference. It is evident that the new factor in financial affairs is not welcomed, and many foreigners will not be convinced of the importance of American capital and its effect on financial affairs throughout the world. Aside from these considerations, there is another important feature in the failure of the syndicate to make a satisfactory agreement, and one far more important to the country at present, at least. It is the fact that the breach between the American and French financiers will probably result in throwing an immense amount of copper on the market, and eventually reduce the prevailing prices. This will be appreciated by Americans in general, and the benefits will be enjoyed by all.

The Schuyler company has made an offer to furnish a plant with a capacity for sixty arc and 1000 incandescent lights to Alexandria, Va., for $14,000.

Western Electrician.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome, and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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PROBABLY the best lighted residence in Chicago is Potter Palmer's palatial home. Illustrations and a description of an installation which was recently completed there are given in another column. The plant has many interesting features, and it affords an illustration of the practical value of storage batteries.

WILL Cleveland's executive head follow Mayor Grant's example, and remove overhead wires? The press of the city are urging him to [illegible]. A Cleveland paper says: "The wire nuisance should be abolished, and the only way to do this is to stop talking and act. It is over [illegible] providing for putting the wires underground in the central part of the city was passed, and yet nothing has been done by the corporations using the streets, nor will anything be done until the city authorities show [illegible] determined to enforce the [illegible] will stop, and the [illegible] Cleveland can probably wait a short time, at least, before heroic treatment of the problem is necessary.

[illegible] of the [illegible] the question [illegible] for contempt [illegible] It [illegible] of the [illegible] at Albany [illegible] diction to compel the relator to answer the question and furnish the telegrams demanded, and that his committal for contempt on refusing to comply with the requirements of the committee was without jurisdiction and void, and that he must, therefore, be discharged."

IN the last issue of the WESTERN ELECTRICIAN attention was called to the fact that public sentiment in the Empire state would oppose the utilization of the vast water power of Niagara. In this connection, the following editorial published in the New York *Sun* since the article in question appeared, will be of interest: "The bill to authorize a Hydraulic Electric company to erect machinery under Niagara falls, and to use for that purpose the lands of the state reservation, ought to be put to rest forever. The people of this state have paid liberally for the Niagara reservation. Its purpose is to preserve the cataract uninjured as a public spectacle, and to save its grandeur and beauty from being destroyed by such uses as this bill contemplates. We trust that the scheme will be so promptly and so energetically rejected by the legislature that it may never be offered again."

AN invention of Edward Fales, of Philadelphia, has been widely commented upon during the last few months. It was stated to be a fuel saving device, which was so efficient that a new industrial era was predicted. The wildest stories were related, but investigation has revealed the fact that it is nothing more than a commonplace invention. It is now stated that the inventor, by a change of draft arrangements, appears to be able to save a small portion of the caloric which is otherwise wasted in obtaining power from fuel, but that is all. An exchange, in commenting on the alleged invention, says: "It is difficult to say what will be the next achievement in this march of progress, because an intelligent guess at an improvement is half way to its discovery. But the most inventive minds of the age are at work on the problem, and there need be no fear that they will not succeed before long in eliminating a large part of the outstanding loss of energy which now occurs in every case where man attempts to transform it or change the character of its operation. But the work will have to be done by building up on what is already known as a foundation. The superstructure must be achieved in the usual way by proceeding upward, not by beginning at the roof and working down. To the latter kind of effort the alleged discovery in Philadelphia seems to belong."

THE several storms in the East and the terrific gales in the West played havoc with wires of all kinds last week. In Minneapolis considerable damage was done to the telephone circuits by the crossing of the electric light wires. The fact that the electric light, telegraph and telephone lines were impaired in several cities has caused the papers to renew with vigor their warfare against overhead wires. The St. Paul *Pioneer Press* takes up the matter, and an extract from an editorial which appeared in that paper is appended. It is not presented because the opinions which it expresses are indorsed, but merely to show the effect which the New York pole chopping is having throughout the country. It says: "The furious gale which for the greater part of two days raged through our streets, tossed and tangled the wires into an almost inextricable confusion. It was impossible to prevent it in the network of iron that now stretches between street and sky; and it was equally impossible to make any effort to correct the evil as long as these high winds prevailed. As a consequence, the telephone service was badly demoralized. Certain districts of the city were cut off practically from fire protection by the crippling of the fire alarm service, and people who found that their telephones would not work were admonished to be patient until the linemen could get the wires straightened out again. Why should they be patient? Why should anybody be patient with the continuance [illegible] of the admitted nuisance of overhead wires? Fortunately the practical aspect of the question is no longer open to argument. We [illegible] fact, that electric wires of all sorts can be operated satisfactorily through subways. We know that the companies understand this, and are ready to take practical measures for putting their wires underground whenever they have to. And we know, moreover, that they will not do anything short of compulsion. New York worried over this same question for years and years, appointed and maintained to no purpose an expensive electrical commission, and is just now settling the whole business to the public satisfaction in the shortest possible order by cutting down poles and removing wires without regard to supplication or protest. The cost of undoing the work of the wind in the last few days would pay a considerable share of the cost of maintaining subways; not to count the much more serious damage of sleet storms in winter. Yet, although certain franchises have been granted by the council, and others applied for, we see no more prospect of having the wires underground in St. Paul than there was five years ago." The editorial concludes with a criticism of city officials who are derelict in their duties. While hasty unconciliatory opinions of this kind cannot be approved, they are interesting as showing the position which the press of the country is taking in this matter.

IN another place is given a short account of the victory of the telephone company in St. Louis in the litigation growing out of its controversy with the city authorities. When the municipal assembly passed an ordinance reducing telephone rates from $100 to $50 the company began to take out instruments as rapidly as the contracts expired. A compromise was effected while an appeal to the courts was made, by the terms of which subscribers agreed to pay $50 per year if the Supreme court found the assembly had the right to regulate the rates, but $100 if the decision was in favor of the company. The telephone company's position was sustained by the court, which found that the right to regulate telephone charges had not been delegated to the assembly by the legislature. Some of the subscribers, however, insisted on paying at the $50 rate in spite of the decision, and a test case came to trial last week. The suit did not go to the jury, as the presiding judge found the law so plainly in favor of the company that he directed a verdict in its favor. The Missouri legislature did not see fit to pass the Dempsey bill, which reduced so radically telephone charges throughout the state. The senate, however, last week passed a bill which is specially dear to the St. Louis authorities. It confers upon cities and towns the power to regulate charges for telephone service, and the conduct of the business.

IT is stated that plans for inflicting the death penalty in New York state by electricity are substantially completed. The condemned criminal will be placed in a strong oaken chair. His head will be covered with a metal cap, on the inner side of which will be a sponge saturated with salt water. He will wear a tightly laced pair of shoes, in each of which will be a damp sponge. The circuit will be closed for fifteen seconds. Apparatus for the infliction of the penalty under the new law has been purchased, and plants are to be installed at Auburn, Clinton and Sing Sing. The report was sent out from New York by the press associations that dynamos of a certain make had been bought for this purpose. The statement was indignantly denied by the makers of the machine in question. They asserted that the report had been circulated by rivals in order to injure their business. The explanation seems to be that the dynamos were not purchased directly from the manufacturers, but from a gentleman whose name has been prominently before the public in connection with testing the effects of deadly currents on animals.

A dispatch from Buffalo has a certain ghastly interest in this connection. A message states that William Kremmler has been found guilty of murder in the first degree, and will be the first criminal executed by electricity. There are a good many chances for a condemned man to escape even in New York state after sentence has been pronounced, but the Buffalo correspondent speaks of the execution as a certainty.

Standard Electric Company's Electric Light System.

The new electric light apparatus of the Standard Electric company of Vermont is shown in the accompanying cuts. Fig. 1 shows the Standard incandescent dynamo, which weighs 1,350 pounds, and has a capacity of 300 16 candle power lamps. The principal feature of the dynamo consists in the methods of applying the copper conductors to the armature, by means of which all the electrical features of a perfectly closed circuit armature is enabled to run in a multipolar field, and to deliver a direct and continuous current from a single pair of brushes, the same as is obtained from an ordinary two-poled dynamo used for incandescent lighting. The electromotive force generated is determined by the strength of the magnetic field through which the conductor or the armature passes, and by the rapidity with which the inductive impulses caused by the revolutions of the armature succeed each other: hence, by the use of a larger number of field magnets, so arranged that the effect of each is cumulative upon that of the one preceding it, a given amount of electromotive force may be generated with much less speed of rotation of the armature. It is stated that current to the full capacity of the armature can be generated not only at a reduced speed, but with a very greatly reduced weight of iron and of copper wire in the field magnets. These features are not derived entirely by the use of the multipolar field, but are partly due to the manner in which the wires or conductors are arranged on the armature. The iron core of the armature fills all the space embraced by the poles of the field magnets as closely as it can and have room for it to revolve, thereby reducing the resistance of the magnetic circuit to the lowest possible degree.

The copper conductors are embedded in narrow grooves, and are almost entirely surrounded by the intensely magnetized iron of the armature, and are thereby subjected to the highest possible inductive effect while passing under the field magnets. These results are obtained with the simplest forms of construction, and without the development of heat in the machine.

Fig. 2 shows the armature with the inductor bars embedded in the iron core. The bars are separated from the iron by fireproof insulation. The connectors at the ends of the armature bars are separated by air spaces, and require no insulation.

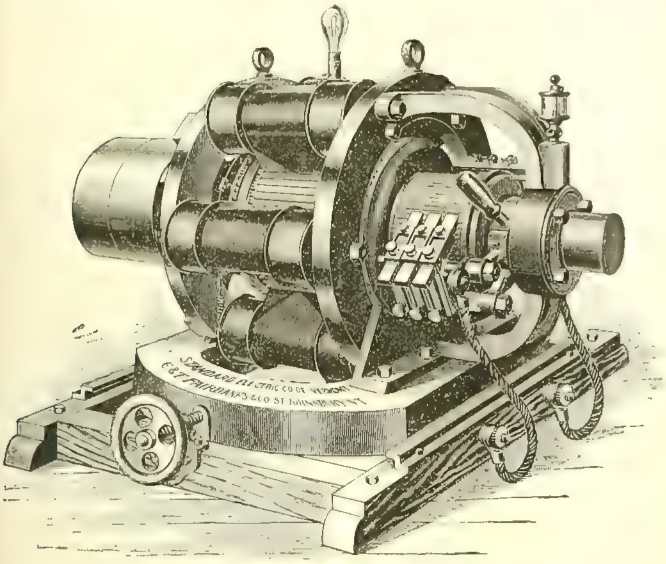

FIG. 1. STANDARD ELECTRIC COMPANY'S ELECTRIC LIGHT SYSTEM.

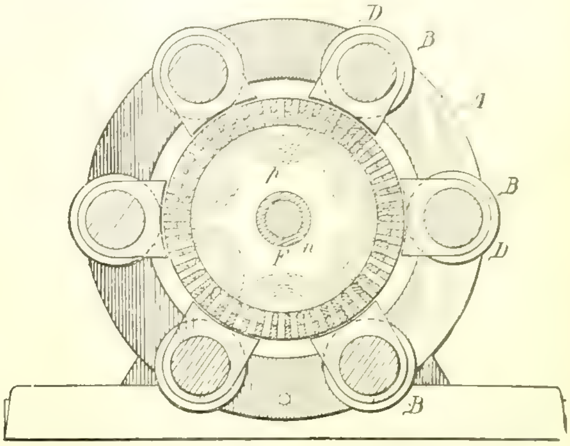

FIG. 3. STANDARD ELECTRIC COMPANY'S ELECTRIC LIGHT SYSTEM.

In the magnetic circuit, as shown in Fig. 3, there are six magnets round the armature, each alternate one being of opposite polarity.

The part of the magnetic circuit between the magnet and the armature is shown by the dotted lines *p*. The iron core of the armature *F* fills the whole space between the pole pieces, and the inductor bars are embedded in the armature so as to receive the highest inductive effect from the highly magnetized iron, as they pass in succession under the field magnets. Fig. 4 shows the Standard arc dynamo; the frame and bed-plate of the dynamo are made of soft iron, cast in one piece. The bearings which support the armature are bolted to the bed-plate; thus perfect solidity is secured. The magnets are secured to the frame by bolts passing through the magnets and pole pieces. The armature is of the Gramme ring type. The wire is double covered, and the coils are insulated from each other to prevent the possibility of a short circuit. The commutator is made of hardened copper with mica insulation between the bars. The radial arms have grooved screw connections to admit the armature wires, hence no soldering of the connections is required. The brushes are adjustable while the machine is running, and the yoke permits their free movement around the commutator for the purpose of adjustment. The

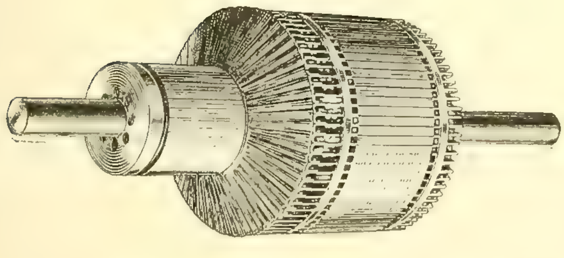

FIG. 2. STANDARD ELECTRIC COMPANY'S ELECTRIC LIGHT SYSTEM.

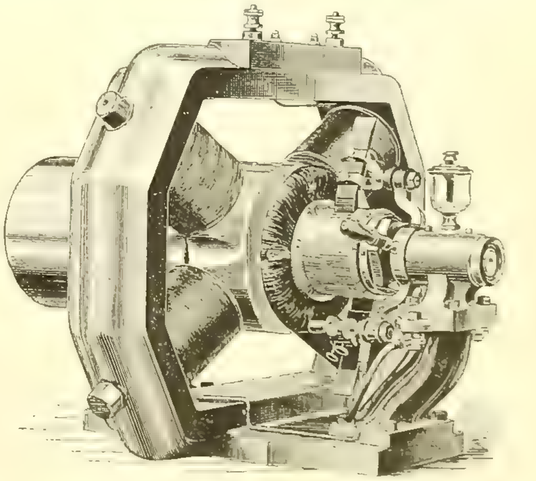

FIG. 3. STANDARD ELECTRIC COMPANY'S ELECTRIC LIGHT SYSTEM.

[illegible]

Conduits in Minneapolis.

[illegible] claimed, did not confer on the company the power to construct manholes. The city attorney, a week ago, was called upon to decide whether the company had the right so to do. In his opinion he says he can find no such authority either in the ordinance approved Oct. 10, 1887, granting a franchise to the National Subway company, or in the general underground wire ordinance, approved Dec. 10, 1886, for the construction of manholes. In the application to the city engineer for space by the subway company nothing is said about manholes, and no space was assigned for that purpose.

The only semblance of authority, said the city attorney, is a motion passed by the city council Nov. 2, 1888 authorizing the superintendent of the fire alarm service to give such time as may be necessary to see to the construction of necessary laterals and manholes in connection with the laying of the conduits, to permit the proper distribution of city wires, and to see that the city's interests are fully protected. This did not authorize the construction of the manholes which have been put in as [illegible] only to the making of proper provision for the city wires. The National Subway company seems disposed to postpone putting in any other manholes until some [illegible] of the matter can be made. But inasmuch as this is a question that will arise whenever any [illegible] are put under ground, I recommend that some plan be [illegible] regarding manholes and service boxes and that the general ordinance be amended so as to provide for them in accordance with the plan that may be agreed upon.

The city engineer is examining plans and specifications submitted by the Edison [illegible]

[illegible] conduits. The ordinance under which the Dorset company has operated exclusively has been amended so as to [illegible]

Gas and Electricity.[1]

[illegible]

Whether or not the hitherto even-tempered existence of [illegible] with a load of volts, ohms, amperes and watts, is an important query, and shou'd not be lightly dismissed, nor decided without a careful, unprejudiced and thorough investigation. To one who has been interested in the combination of gas and electricity (a combination not effected without that searching inquiry that was and is necessary), it may be permitted to speak whereof he knows, and give his reasons why it is not only eminently desirable, but economically certain, the best course for a gas company to pursue.

Your practical gas man wants facts, not theories, and his own judgments strengthened by these facts will put him in a position to decide his own case without the intervention of any interested party.

There are many reasons why a gas company can operate an electric light plant to the advantage of the stockholders, and the mutual benefit of the consumers and company's interest, of which I will briefly give a few:

An electric light station, to be properly conducted, needs at its head a man of sound judgment, quick perceptive faculties, a thorough knowledge of steam and its economical production, the tact necessary in dealing with people, and withal that training in the hard school of necessity that will not brook defeat; all these, and more, are possessed by your average gas superintendent.

The station should be located on the grounds of the gas works, and should be built for a capacity double that which at the time erected is thought necessary, as experience has proven that no electric light station ever built and properly run was large enough. In all gas yards there is more or less room, and the advantages gained are innumerable. There is an opportunity to utilize the byproducts, which in many cases are nuisances, and can, under boilers, pay a large interest; this is particularly the case where a company is operating the oil and coal processes; as coke breeze, generally unsalable, combined with the residuum of oil, makes an excellent fuel; hot coke drawn from the retorts makes an economical method of starting fires. Again, by the exercise of that economy which is the patent right of a gas man, the many little leaks, that the professional electric light man has achieved a national reputation for, are stopped, and the pennies saved become pennies earned. Your material is purchased cheaper, or in a better market, because of your knowledge of the matter of purchase of supplies, and of the men from whom you buy. You are not out anything for clerks or office expense; there is always a man or two about the works who can be spared for an hour or two to trim lamps and do other odd jobs that, with the separate station, mean a man at a stated salary per month, whose time is not half employed. These savings seem trifling, but summed up, they are the foundation stones of a balance on the right side of the ledger at the close of the year's business.

As an answer to the statement that gas consumers demand an opposition, and that gas and electric lights operated by the same company only tend to the creation of an opposition, I think it is sufficient to say that opposition is created in the main by the parent company, either by high rates or poor service, or both. Given a company operating with gas alone, or in conjunction with electric light, and maintaining a thorough accord with its consumers by a service that would be expected by the company if positions were reversed, and an opposition would not attempt to gain a foothold except for the purpose of blackmail, and this kind of an opponent is readily recognized by the mass of people, and will and always has been allowed to [illegible] it deserves.

[illegible] electric lights are as a rule too high, and the fault lies not so much with the companies operating, as it [illegible] the seller of the plants, who, to make a high margin or profit apparent, knowing that because of its novelty the light will be sought after, do when installing a [illegible] rate that will appear to the purchaser as a rich investment, and the purchaser, running it at those rates, invites another company, perhaps represented by the same man who sold him the first plant, to come in, and by offering the light at a much reduced rate, and still at a [illegible] give your customer a chance for dis[illegible]. [illegible] a gas company, when installing an [illegible] consideration of rates the [illegible] question of gas rates, [illegible]

[illegible] gas company could main[illegible] must take rank [illegible] attractive; the [illegible] collector, who [illegible] little forbearance [illegible] his bill, the [illegible] he has learned [illegible] the free [illegible] [illegible] of gas [illegible] price that will yield the same rate of profit on [illegible]

[illegible]

A Test of a Motor.

In a recent test of one of the new Sprague motors made at the factory of the Sprague Electric Railway & Motor company at Schenectady, N. Y., one of the armatures was placed in a tub of water and allowed to soak for twenty-four hours. It was then taken out from its bath and put into position in the machine, and worked up to full load without developing any defect. After this treatment it was again removed from the machine and placed in a tub of salt water, where it was allowed to remain for another twenty-four hours. It was again placed in the machine, and after the commutator had been dried the motor was worked up to over 33 per cent. above its normal load for two to three hours without showing any defect, or bad result of its treatment. The test indicates that results which would have been considered impossible a year ago are now possible, and that the electric motor considered as a machine is stronger and more reliable than a steam engine or any other power producer. Some time ago, it will be remembered that Mr. Sprague said that he would accomplish just such a result as has been shown in this test, and that after soaking the armature for twenty-five hours in the water he would put it in a machine and work the machine up to its load.

CORRESPONDENCE.

New York Notes.

New York, May 11.—The board of trade has come out flat-footed for Mayor Grant at last, and will support him in his war on overhead wires. For a time a few members appeared disinclined to take part in the controversy, but when the issue was forced they fell in line. The officials of the Western Union say they will get their cables in time to have the wires in lower Broadway and Park place buried at the expiration of thirty days' grace accorded the company, and then the clearing out of the poles and thousands of wires will begin. In the meantime the work of taking down the wires and poles on Eighth avenue and Forty-second street is progressing. The work has already cost the city over $11,000. Mayor Grant's bill providing that the comptroller shall be furnished a statement of the expenses incurred in the removal of the poles and wires and, through the corporation counsel, shall levy upon the property of the companies owning the obstructions to recover full cost of their removal, has had a third reading and will doubtless become a law before the legislature adjourns. Mayor Grant told Commissioner Gibbens the other day, with a laugh, that his private telephone wire had been cut on Fifty-eighth street. The wire runs under Sixth avenue to Fifty-eighth street, where it emerges from the ground and proceeds by pole to the mayor's house in Seventy third street.

The bill which has just passed the senate, prohibiting the substitution of steam power by any street railway company now operating horse cars, is clearly intended to confine street railroads to the use of horses, for the remarkable decision of the Court of Appeals that cable power is steam power will probably cover electric power as well. There is no necessity for such a law, for the use of steam locomotives in the streets is prohibited by the charters of the street railway lines. It looks as if the senate bill was either in the interests of Jay Gould to save the elevated roads from the competition of electric and cable roads, or in the interest of some of the Albany lobbyists. It is hoped the assembly will reject the bill. It is probable if it is passed the governor will veto it, as he has shown his great interest in the welfare of New York by his effort to save the mayor's rapid transit bill. It looked as if the bill was surely doomed, but through the efforts of the governor it was resurrected and may yet be passed.

The state has purchased three dynamos to be used in the execution of murderers under the new law. The machines are to be installed at Sing Sing, Auburn and Clinton. The experiments conducted by experts have just been supplemented by corroborative evidence of the most decisive character. John Maroney, a laboring man employed in the Hudson river tunnel, slipped and fell against an electric light wire. He unfortunately struck a portion where the insulation had been worn away, and was instantly killed. The only mark on his body was a little blue mark on his arm where he came in contact with the wire.

The electric lighting apparatus at the Union Square theater was burned out this week and about $500 damage done. The fire was caused by a broken wire of the Brush Electric Light company coming into contact with the wires of the Manhattan Electric Light company, which supplies the theater.

On motion of Attorney General Taber, a judgment dis[illegible] the Electric Sugar Refining company was given by [illegible] in the supreme court. [illegible] Burnham Moffett [illegible] appointed receiver and directed to furnish a bond of [illegible]. The affairs of the concern were brought prominently before the public earlier in the week. The criminal action was called May 6th. Among the prominent actors in this fiasco who were present were the ex-Rev. William E. Howard, the father of his co defendant, the portly Mrs. Olive E. Friend, who is alleged to be the chief conspirator in the electric sugar fraud, Howard's wife, and Augustus and George Halstead. All of them except Howard have languished in the Tombs, while the ex-clergyman has grown brown and hearty in Michigan, because they could not get bail as he did Three indictments for grand larceny were originally found against Howard and his co-defendants. One of them charged them jointly with obtaining $6,500 by fraudulent representations from Lawson N. Fuller. This had been replaced by a new indictment in three counts, alleging that the money was obtained from Mr. Fuller, from the Electric Sugar company, and from President Cotterill and Secretary Robertson. Lawyer Howe, who appeared for the defendants, demurred, on the ground that the new indictment contained additional charges not in the indictment upon which the lot were extradited from Michigan. Recorder Smyth overruled the demurrer. Then Mr. Howe asked leave to enter a special plea of not guilty as to the first count, and to decline to plead as to the second and third counts. District Attorney Fellows said that the bail that Howard gave under the old indictment did not hold good as to the new indictment. So Howard had to fall in, very ruefully, with the procession of his co-defendants and march back with them to the Tombs. The following day another hearing was given, and the defendants entered a plea of not guilty to the charge in the first count of the indictment, and as they refused to plead to the second and third counts, Recorder Smyth ordered pleas of not guilty entered and set the case down for trial on May 20th.

The erection of the proposed marble arch to replace Stanford White's centennial arch over Fifth avenue at Washington square, is now practically assured. The art committee has appointed a committee of thirty-four to raise money and erect the arch. The question of material was determined in favor of marble, which was in accordance with Mr. White's design. It is hoped to raise $100,000 for the erection of the triumphal arch by popular subscription, and $50,000 for embellishing it. Mayor Grant has promised to assist in the undertaking. The committee has already organized and proceeded to business, electing the following officers: Chairman, Henry J. Marquand; vice-chairman, Gen. Louis Fitzgerald; secretary, Richard Watson Gilder; treasurer, William Rhinelander Stewart; finance committee, Brayton Ives, Louis Fitzgerald, J. Hood Wright and Charles S. Smith. Three members of the committee of thirty-four subscribed for $1,000 each, and several smaller subscriptions were received. The Society of American Artists has begun a subscription to the fund. Already a large sum has been raised, and the project is insured success. The illumination at night of the arch has done much to command the attention of the admiring public, and the incandescent electric light deserves its share of praise in making the arch a permanent memento of the great centennial celebration.

At the annual meeting of the stockholders of the New England Telephone company directors were chosen, who in turn elected the following officers: President, Thomas Sherwin; vice-president, Henry S. Hyde; treasurer, Wm. R. Driver; secretary, Fred J Boynton; general manager, Jasper N. Keller; executive committee, Thomas Sherwin, Moses G Parker and John E. Hudson. The treasurer's annual report showed that the gross earnings for the year were $1,127,307 40; expenses, $856,580.87; net earnings, $270.726.53. As compared with the report of 1887, there was an increase of gross earnings, but there was an increase of expenses greater in proportion than the increase in receipts, and the net earnings were correspondingly less.

W. H. T.

St. Joseph, Mo.

St. Joseph, May 11.—The history of the telephone in St Joseph is a history of progress. In 1883, when the number of subscribers had reached 200, the ownership of the plant passed from the local company to the Missouri & Kansas Telephone company. In two and a half years 89 new subscribers were added. The management of the exchange is now under W. W. Yenowine, who has been in charge since April 1, 1885 There are to-day 700 subscribers, and the number is rapidly increasing. Under Mr. Yenowine the company has taken down all the old wires and substituted cables, has put in a new multiple switch board, and built toll lines to Troy, Kansas and Savannah, and a new line across the country to Kansas City. When the present company gained control only three operators were employed in the central office—two in the day, and one at night When Mr. Yenowine took

charge there were three in the day and one at night. At present there are nine day operators, one extra at noon, and in the evening for relief, three from 7 to 9 P. M., and two the remainder of the night. This number includes the toll line operator and the chief operator, the latter having been added about two months ago. The increase of business necessitated the introduction of the multiple switch-board, which puts the operation of the exchange here on the same plan with larger cities. The switch-board has been in operation about a month. The service is greatly improved of late, and it is expected when the operators become more familiar with the use of the switch-board there will be less cause for complaint. Many complaints of poor service are made by persons who do not know how to use a telephone, and many unreasonable charges are made. Manager Yenowine, in speaking of the service, said recently: "If there is cause for complaint I want subscribers to notify me direct. Then there will be an opportunity to remedy it. That is my duty, and I am doing all I can to improve the service. I know many complaints are made without good cause. When people understand that it is much easier for the operators to give the numbers called than to answer, 'They're talking now,' they will know how busy the St. Joseph lines are. There is no question but we can improve the service, but to do this the subscribers must help us. They should above all things answer promptly when there is a call, and confine the use of the telephones to themselves and their employes. The Dempsey telephone bill has been defeated in the legislature, and I sent down a petition to Senator Moran, signed by over 100 of our subscribers, who said that good service was more essential than cheap service, and that the service in St. Joseph was excellent. The service is now improving, and will be better." D.

Kansas City, Mo.

KANSAS CITY, May 11.—The machinery for the Armourdale electric railway, which is being constructed by the Thomson Houston company, has arrived, and is being set up in the power house of the Fifth street cable line which belongs to the company operating the Armourdale line—the Metropolitan Street Railway company.

Charles Rusling of the Thomson-Houston agency has been called east by the illness of his father.

The Edison company is arranging for motor service and furnishing lights during the day. It has been giving night service for some time.

The Kansas City Electric Light company furnished 45 arc lights for the Gilmore jubilee festival at the Exposition building. It will also furnish Oklahoma Hill's Wild West show with 15 arc lights next week.

The Southwestern Electrical Supply company's offices have remained closed all week on account of the death of Harry Lasell, brother of Edward Lasell, the treasurer of the company.

The extreme measures adopted by Mayor Grant of New York have set electric companies elsewhere thinking, with a view of preparing for such an emergency. In speaking of this matter E. R Weeks, president of the National Electric Light association, said: "I do not think that Mayor Grant's course is the correct one, but I also believe that the companies may be somewhat to blame in the matter. Each side, I believe from what I can learn, has been somewhat unapproachable, and it does seem as if all the trouble could have been avoided if proper steps had been taken by each side to secure a mutual understanding. If I had the difficulty to deal with, and believed that it was impracticable to operate underground, I would try to convince the authorities that such was the case by putting down an experimental piece of conduit, and showing that I did my best to make it work. I believe that the action of Mayor Grant caused as much trouble for residents of New York as the companies, and will really delay the adoption of underground wires." P.

Omaha, Neb.

OMAHA, May 11.—The Standard Underground Cable company of Pittsburg, Pa., has begun an action to recover $2,465 in the United States District court against the Red Cloud Electric Light company, the Western Engineering company, the Red Cloud National Bank, the National Exchange Bank of Kansas City, and R. A. Jones. The bill is for wire, reels and other apparatus used in the Red Cloud Electric Light company's plant. The complainant avers that when the goods were sold to the Red Cloud Electric Light company, the said company had a lease upon the grounds where the building stands, and had the right to certain quantities of water conveyed from the Republican river across the property of the Red Cloud Milling company, and that the Electric Light company owned the machinery and appliances necessary in running the plant.

The Omaha Street Railway company has let the contract for putting up [illegible] poles, though it has [illegible] the contract for the electric system to be used. The erection of poles to carry electric wire has already been [illegible] along the route over which the line will extend [illegible] cludes Saunders, Cuming, Sixteenth, Leavenworth street and Park avenue.

The attack now being made on the legality of the consolidation of the horse and cable roads was not unexpected. The right of the company to build is questioned as well as the legality of the issuance of bonds for $750,000. It is feared by property owners, who were waiting for electric service or extensions of lines, that the litigation may [illegible] improvements. The officers of the consolidated company were seen to-day and say, however, that the litigation will not cause them any trouble. P.

St. Louis, Mo.

ST. LOUIS, May 11.—At a recent meeting of the Board of Public Improvement a formal notice was presented by the Brush Electric company of Cleveland. The board was notified not to use double lamps in lighting the city unless they were manufactured by the Brush company, as all double carbon lamps, it was asserted, were infringements on patents issued to C. F. Brush of Cleveland. Mr. Bagnal, St. Louis representative of the Brush company, says that the company will shortly institute suits against all manufacturers of double lamps, as well as against all companies using a differential magnet in their lamps, either single or double.

Mr. Ayer, representing the Jenney Electric company of Indianapolis, which will furnish the contractor with all the necessary apparatus for lighting the city, claims that his company has a written agreement, signed and sealed, with the Brush company of Cleveland, whereby it is authorized to construct double carbon lamps, also to use the differential magnet in its lamps.

The Missouri Electric Light company is rapidly completing its station pole lines. The inside work is all done by contract. The Keystone Wiring company and the Porter Construction company are the contractors.

C. S. Sanderson of the National Carbon company has been in the city.

The St. Louis Battery Manufacturing company is figuring on several large orders

H S Graber, electrician of the Western Union Telegraph company, is making improvements in the method of generating electromotive force for use on telegraph circuits.

W. R Ryder, an employe of the Missouri Bell Telephone company, while at work on one of the company's poles, received an electric shock and fell to the ground, a distance of thirty feet, striking on his head. His skull was fractured, and he died before an ambulance arrived. Ryder was 27 years old, single, and was a comparative stranger in the city.

The St. Louis Subway company has filed its plans with the Board of Public Improvements. It is claimed the plans were incomplete, as the company did not show the gas or water pipes, or even the railroad tunnel under Washington avenue. The board refused to approve the plans until they were made much more elaborate

The Board of Public Improvements will visit Chicago and inspect the subways there. B.

ST. LOUIS, May 11.—The books for the transfer of Gas Trust certificates closed Saturday. About 50,000 shares have been signed, with 10,000 still out. This practically assures the success of the trust and the ending of the long controversy between the companies. A telegram was received Saturday announcing the acceptance of the option on the Laclede property, and stating that $500,000 had been deposited to bind the bargain.

Several of the projected electrical roads are meeting with great opposition from the citizens along the lines, but that did not prevent the presentation of a new scheme for an electric elevated road in the municipal assembly last week. It is proposed to start at the intersection of Magnolia and Tower Grove avenues, and run west on Magnolia avenue to King's highway. The road will connect with and act in conjunction with the Missouri Railroad company, and one fare will entitle a passenger to a ride over both roads.

The wiring of the city, which was stopped a short time ago by the president of the Board of Underwriters, will probably go on, as the Board of Public Improvements appointed a committee to discuss this matter and settle on a plan that will be acceptable to the underwriters

The engines, boilers, pipe work and fittings which the Pond Engineering company has been putting in for the Edison Electric Light & Power company, Kansas City, Mo., are in position and have been formally accepted by the Edison company's representatives. The steam was turned on and everything tested to the satisfaction of the gentlemen present, who are very well pleased with the

[illegible]

Louisville, Ky.

[illegible]

[illegible] of Boston, is doing the work. Two 80-horse power Thomson-Houston dynamos will furnish the motive power. Ten cars will run on the two tracks.

John H. [illegible], president of the [illegible] company, is in Chicago.

The following officers of the Kentucky Phonograph company have been elected: H. V. Loving, president; L. Leonard, vice president; Oscar Fenley, treasurer and secretary; and J. Campbell Scott, manager.

Thomas G. Gaylord, manager of the Louisville Electric Light company, is in Cincinnati. A.

Topeka Kan.

TOPEKA, KAN., May 10.—In the United States Circuit court Tuesday Judge Foster gave an important decision in the case brought by the American Bell Telephone company against the Hutchinson Water, Light & Telephone company. This is one of the numerous controversies which have arisen in the courts in various parts of the country for infringements of the Bell telephone patents. The telephone company at Hutchinson has been using the Cushman and other telephone instruments which have heretofore been declared infringements on the Bell. Proceedings were brought before Judge Foster to restrain the company from further use and to recover damages. The attorneys for the Cushman company applied before Judge Brewer at Kansas City for an order dismissing the case to await the determination of the suit brought by the government. Judge Brewer overruled the application a few days ago, and the case came up for hearing before Judge Foster. Judge Foster, after hearing the argument, granted the injunction in favor of the Bell Telephone company, and reference was made to Irwin Taylor to take testimony and report the amount of damage due the Bell company. The defendants gave notice of an appeal, and took exceptions to the decree. The operation of the decree was stayed until June 10th. R.

Pittsburg, Pa.

PITTSBURG, Pa., May 11.—A new class of craftsmen has sprung up all over the country within the past six or seven years. The class spoken of is known as "electrical" or "special" plumbers. Their duties are to weld the points of subway cables, and to do this successfully they must not only be first class plumbers, but intelligent workmen, who can learn something about electricity and the necessity of perfect insulation of circuits. Few people who have watched the placing of underground cables can appreciate the important part the electrical plumber plays in the matter. In a talk with F. G. Acheson, electrician of the Standard Underground Cable company, yesterday, it was ascertained that there are less than [illegible] electrical plumbers in the country, but they are increasing with the demand. The recent action of Mayor Grant of New York, in ordering that all wires upon streets where conduits have been laid, must be placed underground, has caused an enormous amount of work to be thrown upon the [illegible] underground cable companies in the country. They have been unable to get all the plumbers necessary to do the work. Ordinary plumbers, who are good mechanics, are not able to fill the bill. The trouble with most green plumbers is that they cannot stand sewer and other gases common under most streets. The Standard company tried to teach a number of them the business in New York, but the men gave it up. The honor of introducing this class of artisans belongs to this city and a well known electrician of Pittsburg. In 18[illegible] Wm. [illegible] of the Standard Underground Cable company [illegible] the necessity of having men learn this part of the business [illegible]

[illegible] a plumbing shop and [illegible] this city. They soon learned the business, and have been doing nothing else since. The salary of an electrical plumber is about $5 a [illegible]

H.

Nashville, Tenn.

[illegible] M[illegible] [illegible]lle's electric railway, which was completed the 1st of the month, has since been in successful operation. It is six miles in length, reaching from the Maxwell house in the center of the city to [illegible] [illegible] will be added. The company operates six cars, and the Thomson-Houston system has been adopted. The new road did a thriving business during the Nashville races. E. E. Vining of Boston, superintended the construction of the electrical apparatus.

Knoxville will have an electric railway soon, and the improvement is receiving encouragement on every hand. The smaller towns throughout the state are rapidly adopting the use of electricity for lighting and motive power

H.

THE ELECTRIC LIGHT.

West Dallas, Tex., capitalists want to light the suburbs with electricity.

A Westinghouse 500-light incandescent plant is being put in at Corvallis, Ore.

The common council of Eureka, Cal., has authorized the use of the Brush street light.

The South Omaha Electric Light company is considering the question of enlarging its plant.

The Thomson-Houston company has petitioned the Anniston, Ala., council for a franchise.

The Thomson-Houston company has sold a 600 light incandesdent plant to Hill & Bell, Auburn, Cal.

The new $17,000 Thomson-Houston electric light plant at Winchester, Va., is now completed and in operation.

The Westinghouse Electric company has obtained the contract to put 500 Waterhouse arc lamps along the streets of Philadelphia.

The city council of Oil City, Pa., has decided to light the streets of the city with 100 arc and 600 incandescent electric lights of the Thomson-Houston system.

A telegram from the City of Mexico says that the municipal authorities propose to remove electric light poles from its streets. Telephone and telegraph wires will also be buried.

The Philadelphia city council has petitioned the legislature to reject the proposed bill authorizing electric light companies to erect poles and lay conduits without permission of city councils.

The Tokio, Japan, Electric Light company has increased its capital stock from $250,000 to $500,000. Electricity is advancing rapidly in public favor in the land of the Mikado, especially for illuminating purposes.

The Baltimore, Md., councils have decided to renew the electric lighting contract with the Brush company. The lights will be of 2,000-candle power instead of 1,200, as formerly, and the contract will be in force for one year.

The Manhattan Electric Light company, limited, of New York, will decide, at a meeting of its stockholders on the 20th inst., the question of increasing its capital stock from $100,000 to $1,000,000, the additional stock to be divided into shares of $100 each.

A Grand Rapids paper says: "T. C. Harnish of the Peninsula Electric company returned from St. Joseph, where he secured the contract for installing 400 electric lights in Plank's Tavern, the mammoth summer hotel building on the beach near that city."

In the [illegible] select council, May [illegible]th, a resolution was adopted directing the committee on gas to [illegible] proposals for [illegible] electric light plant, the [illegible] for six months by the [illegible] to be bought by the city.

[illegible] Electric company controls the [illegible] Fargo and Moorhead, [illegible] its lines, so as to fur[illegible] and for that purpose [illegible] large additions to its [illegible]

[illegible] preparing for a series [illegible] designed for [illegible] on [illegible] It will be [illegible] of their [illegible] [illegible]

[illegible] to erect or [illegible] electric [illegible] [illegible]

[illegible] had the effect of giving [illegible] franchises. [illegible] [illegible]fering,

but the application was denied. The case will be appealed. Three franchises have already been granted to San Francisco companies, and stock in these concerns is going up.

Complaint is made by shippers of electric light globes from Pittsburgh to San Francisco that the railroads favor the gas companies and give gas globes a rate of $1.50 while they charge $3.10 a hundred for electric light globes. Some of the electric light globe shippers have been trying to get concessions, but the railroad people will not make any.

Duluth, Minn., is not satisfied with its light as supplied by a local gas firm, and it is claimed that the town receives poorer gas service than any other city in the northwest. Therefore it is advocated by some that the city buy the gas plant. This, however, would be but a temporary makeshift, as Duluth is a growing town and will within a few years demand electric illumination.

Edmund W. P. Smith, formerly United States consul at Cartagena, Republic of Colombia, in an interview with a Washington reporter, said that electric lights were needed in that country, and an excellent opportunity would be afforded American capital there. The government is disposed to be liberal to inventors, and special concessions will be made electric light companies for twenty-five years.

The Pullman Palace Car company finished the coaches ordered by the Chesapeake & Ohio Railroad company last week, and on Sunday last the first trips were made by these trains. They are all lighted by electricity. An Echemeyer dynamo, Brotherhood engine and Electrical Accumulator company batteries are used. Hereafter all passenger trains on this road will be illuminated by electricity.

The Western Electric company of Chicago reports the following recent sales: Ashland, Wis., Iron & Steel company, one 12-light, low tension arc outfit and steam plant; city of Elgin, Ill., 40-light, low tension arc outfit; Miller Brothers' dry dock, Chicago, Ill., 125-light incandescent outfit complete, in yards and dry docks; Steubenville, O., Electric Light & Power company, 40-light low tension and 60-light high tension outfit; town of Holly, N. Y., 600-light incandescent outfit and steam plant.

The case of the Edison Electric Light company against the Westinghouse-Church-Kerr company was closed at Pittsburg May 9th, when arguments were submitted. The action is brought for alleged infringement of the multiple wire system of the Edison company. The defendants claim that there is no infringement whatever, and present a number of patents going to show that the system is an old one. The defendants also claim that their patent is entirely of different construction from that of the plaintiff.

The Milwaukee city council has been considering the underground conduit question and the disposition of privileges. In 1883 the telephone company secured the franchise for constructing conduits, and, although it has not availed itself of the privilege, its franchise still holds. The Badger company wishes the city council to revoke the franchise, as the Western Electric company will use the telephone company's conduits, and compete with the Badger company in the heart of the city. The city attorney has been asked for an opinion.

The Westinghouse Electric company report the following sales of alternating current central station outfits during the first week in May: Asbury Park, N. J., 500 lights; Galesburg, Ill., 500 lights; Salem, N. J., (increase) 500 lights; Batavia, N. Y., 1,250 lights. The same company recently took orders for Waterhouse arc lighting plants as follows: Fort Worth, Tex., Electric Light company, 35 lights; Allegheny County Lighting company, Pittsburg, Pa., 50 lights; Hartford, Conn., Light & Power company, 30 lights; American Waltham Watch company, 3 lights; State Insane Asylum, Columbia, S. C., 5 lights and a 200 light direct current incandescent dynamo. Two machines of the latter class were sold, also,—one of 100 lights to Huntingdon Hopkins company, San Francisco, and one of 150 lights to the Charlotte, N. C., Oil & Fertilizer company—for isolated plants.

At the last meeting of the Buffalo, N. Y., Electrical association, J. P. Chapin read an interesting paper on the regulations which insurance companies require of electric companies. He asked: "Were so many precautions taken because of the damage which electric light had caused, or through an unexplainable fear?" And again he inquired: "Why are gas companies not subject to such strict rules? Why are they not obliged to submit samples of their work to the board, and why not compelled to attach an automatic switch to act in case of a leak, or of the gas being blown out?" Mr. Chapin urged the drawing up of standard regulations by practical electricians, the inspection also to be made by men of experience in that line, instead of leaving the matter in the hands of fire underwriters. He thought that the work could be handled far better by men acquainted with the business than by those who sought only to protect their own interests.

Among the recent plants installed by the Thomson-Houston Electric company of Chicago are the following: Iowa City, Ia., 35 arc; Marceline, Mo., 35 arc; Tacoma, Wash. Ter., 50 arc; Mason, Mich., 30 arc; Sparta, Wis., 600 incandescent; Sparks Milling company, Alton, Ill., 50 incandescent; Livingston, Mo., 2[illegible] arc, and 600 incandescent; Fresno, Cal., [illegible] arc; Chicago Arc Light & Power company, 1,000 incandescent; Pontiac, Ill., 600 incandescent; New Ulm, Minn., 600 incandescent; San Luis Obispo, Cal., [illegible] incandescent; N. I. Fairbanks & Co., Chicago, [illegible] incandescent; Tarkio, Mo., 400 incandescent; [illegible], Cal., [illegible] incandescent; St. Paul, Minn., [illegible] company, [illegible] incandescent; Western [illegible] company, [illegible] City, [illegible] incandescent. The following [illegible] [illegible] by the [illegible] [illegible] have been ordered: Madison, [illegible] [illegible], Mich., 20 arc; Missoula, Mont., 20 arc; Peru, Ind., 50 arc; Kansas City Cable company, 20 arc.

Scranton streets were in darkness May [illegible]th except in the extreme suburbs, where they were lighted by naphtha, the Scranton Electric Light & Heat company having shut off the 320 arc lights which heretofore illuminated the street intersections. The cause of the dispute between the city and the company originated some weeks ago, when a New York electrical expert, who made secret investigations, reported that the electric plant could not fill the requirements. Since then there had been objection to paying the bills without deduction, and the councils also claimed the contract with the company provided one free lamp in every thirty paid ones, and it was determined to ascertain the amount so overpaid and retain it from the bills due. The company claims the city has not lived up to contract in meeting the bills, February, March and April amounts being unpaid, although the former month had been approved by the councils, the city controller having withheld signing the warrants on account of the dispute. The bills unpaid now reach $7,300, and the light company will not furnish the illuminant till the amount is paid. Meanwhile the Electric city is without one of its crowning features. Several councilmen declared this action of the company was the entering wedge for the city providing its own electric light.

Copenhagen and Christiana are contemplating the adoption of the electric light on a larger scale. The Danish capital will probably be the one to first move in the matter, and in both instances it is the corporation that is taking up the thing. The Copenhagen corporation owns and works the two principal gas works of the town, and they have hitherto, at least indirectly, discouraged the adoption of the electric light. One of their engineers at the gas works has recently returned from a visit to various large towns, London, Hamburg, Berlin, etc., and is now preparing a detailed plan. The portion of the town most likely to go in for electric light would require one large or two smaller central stations, but the corporation means to erect only one station to begin with, so as to be better able to feel its way. The proposed station will have a capacity of 10,000 lamps, and it is the intention to build it so that this capacity can be doubled when required. The fact of the corporation having taken the matter in hand will, no doubt, put a stop to one or two private projects of some importance, of which there has lately been some talk. In Christiana the question is not so far advanced, although there, too, detailed plans may soon be expected. In Stockholm, finally, the gas works have for the last year or two been negotiating with the town about the conditions for their erecting one or more large stations, but the corporation appears to move very slowly in the matter.

The Denver *Republican* says, editorially: "It is a matter of surprise that the water power developed by mountain streams near Denver is not utilized as a motor force in this city. This is especially applicable to electric lighting. It is to be presumed that the managers of the electric light works in Denver know their business, but, possibly, they have not looked closely into the question of securing the power for their dynamos from some mountain stream rather than steam. Coal is expensive, whereas water is cheap. The power which now is used in producing electric light comes from burning a great deal of coal. The power which a mountain stream generates is born of the fact that it is natural for water to run down hill. A dam could be put in Clear creek above Golden or in the Platte above the mouth of the canon, by which power enough could be generated to light 1,000,000 electric lamps in this city. This is no wild dream. There has been some talk of utilizing a part of the power of Niagara Falls to light Buffalo and other cities in this way. The electricity generated by dynamos situated in Platte canyon could easily be conducted by means of heavy wires to the city. The distance is not too great. There is hardly any limit to the power that could be secured in this way. It could be used for many purposes besides that of electric lighting. Small plants of machinery could be operated by these means. But America is a country of steam, and the Americans have given little attention, comparatively speaking, to the use of hydraulic power."

THE ELECTRIC MOTOR.

The new electric railway at Watertown, S. Dak., will be in operation, it is said, by July 1st.

A Louisville physician is now successfully employing an electric motor in giving massage treatment.

The Thomson-Houston company of Chicago sold seven motors in Denver, Col., nine in Chicago, and four in St. Paul last week.

The Richmond, Ind., electric street railway will be formally opened June 15th. This road will have the Thomson-Houston company's system.

The citizens of Observatory Hill, Allegheny, recently adopted a resolution at a mass meeting, urging the city council to vote for the franchise authorizing the extension of the Observatory Hill Electric railway.

At a recent meeting of the Council Bluffs city council, the ordinance granting to an electric motor company the right to construct a line from the Union Pacific bridge upon certain streets of the city, was called up and passed.

During last week the Sprague Railway & Motor company of New York contracted to build an electric railway to cover the principal streets of Portland, Ore. This will make the third electric railway operated by the Sprague company on the Pacific slope, the other two being at Tacoma, Wash. Ter.

On May 9th lightning struck the wires of the Electric Motor company at Omaha and entered the power house, [illegible] two dynamos considerably. It put a stop to all motive power, leaving three trains "dead" on the track

The damage was repaired in about half an hour, and the trains resumed running.

Work on the electric railway at Rochester, N. Y., is progressing rapidly, and everything will be in readiness for the opening June 10th, the date set upon for that event. The track laying has been nearly finished, and the power house is well under way. Poles are being erected and wires strung. C. A. Deer and W. F. Sheaf of the Thomson-Houston company are in charge of the construction.

Over a year ago the Spokane Falls *Chronicle* company of Spokane Falls, Wash. Ter., decided to operate its presses by electric power, and purchased a 2 horse power Sprague motor for the purpose. Since that time this motor has been running a cylinder press and two job presses at the same time, and is giving great satisfaction. The proprietor of the *Chronicle* says that during this time not one cent for repairs has been expended.

The Omaha Motor Railway company of Omaha, Neb., with an authorized capital stock of $1,200,000, has filed amended articles of incorporation. The stock is divided into 12,000 shares, and it is provided that 50 per cent. of the capital shall be subscribed and paid up within sixty days. The corporation is organized for the purpose of operating street railways by electricity and cable operated by steam, compressed air or any other motive power except steam. The officers are Samuel D. Mercer, president, and W. B. Millard, secretary.

The Plattsmouth, Neb., Street Railway company has closed a contract with the Sprague Electric Railway & Motor company at Kearney, Neb., for a complete electric railway equipment. The Pennsylvania Railroad company has been so well pleased with the operation of the Sprague cars at Atlantic City, N. J., that it has ordered ten more complete trucks. In Binghamton, N. Y., the Washington Street & State Asylum Railroad company has closed a contract with the Sprague company to equip its line with the latest style of motors.

C. D. P. Gibson, manager of the Gibson Electric company of New York, has just returned from New Orleans, where he inspected the working of an electric street car equipped with the Gibson storage batteries. He gives a most flattering account of the working of the car and battery. The car is in commission, and is running regularly. A run of eighty miles was made in one day without recharging the battery, the car making regular trips and carrying passengers. A run of 25½ miles was also made, the electric car hauling two extra cars, at one time carrying seventy-two passengers. The gentlemen interested in introducing the storage batteries into use in New Orleans are very enthusiastic over the results attained.

The Thomson-Houston Electric company of Chicago has been awarded the contract for constructing the Decatur, Ill., electric railway. Eight motor cars, two 80-horse power generators, six miles of track and a 200-horse power engine will constitute the plant when it is ready for operation July 1st. The Ottawa, Ill., street railway which this company is constructing will be one of the best equipped electric railroads in the country. It will have five miles of track, two 80-horse power generators and a 200-horse power Reynolds Corliss engine. Twelve cars are now being constructed, and the road will soon be ready for operation. The power station, a substantial brick building, will be a model of convenience.

Angus Cameron and Thomas Gemmell, of London, England, and Malcolm Sinclair, of Cumberland, Md., have recently instituted an action in the Superior court at Baltimore against the Baxter Electric Manufacturing & Motor company for $50,000 damages, for alleged breach of contract. It is claimed that on March 9, 1888, the Baxter company entered into a contract with Messrs. Cameron, Gemmell and Sinclair, by which the three gentlemen were to organize in London a syndicate to purchase the patent rights of the company for use in Great Britain. The syndicate, it is claimed, was organized, and $30,000 subscribed, when the negotiations fell through on account of the complications in the business of the Baxter company last December.

Superintendent George Mulhern of the Woodland Avenue and West Side line, stood in the Public square yesterday watching Tom Johnson's men stringing wires for the South Side electric road, says the Cleveland *Leader*. "When will your company begin putting up wires?" was asked. "Never, I hope," was the vigorous reply. "Why, have you given up your idea of an electric road after the council has authorized you to build it?" "Well, hardly; but we don't want to put up an outfit like this and then tear it down. You just have patience for two or three weeks and your eyes will be opened. You'll see an electric car on Woodland avenue without any overhead wires or underground conduits to bother about." "Do you mean a storage battery car?" "That's about it. We have a man in the East getting things in shape. We're going to have electricity, any way, but we will not use the wires unless we are obliged to. Storage batteries are the motors of the future on the West Side road."

An Omaha paper says: "The ordinance granting the right of way through certain streets of the Consolidated Street Railway company to Council Bluffs and Omaha has finally passed, and the next move is to secure the right of way across Union Pacific bridge. The ordinance provides that work must be commenced within six months, and a line from the bridge up Ninth avenue to Fourth street, thence to Broadway, must be completed within one year. The projectors of the road are confident that the Union Pacific company will readily agree upon terms, and that work will be commenced considerably inside the specified time. The principal benefit to be derived from the new line is a 5 cent fare between the two cities, and it is claimed that this will never be secured until there is another competing line. The prospects for a new line are now much brighter than was the prospect for the Broadway bridge and the present electric line two years ago, and it seems to be the general opinion of the leading business men of the city that the line will be built.

The Pittsburg *Dispatch* of May 10th tells the following story: Yesterday morning men employed by the Pleasant Valley Street Railway company attempted to plant a pole at the corner of Seventh and Liberty streets, at E. H. Meyers & Co.'s place of business. Messrs. Meyers and Succop ordered a suspension of operations, but the men replied that they at present knew no law except the command of their employers. The firm, when protest availed not, sent one of their heavy wagons to occupy the place of the proposed excavation, and told the men to get out or be run over. The men got, but subsequently telephoned the contractor, who came on the scene and ordered the firm to vacate or be vacated by force. The firm called out twenty employes and told them to hold the fort and they held it. As might have been expected, the street was soon crowded and the nervous feared a riot, but Chief Bigelow and Superintendent Brown were sent for, and they wrestled with Mr. Meyers. Under orders from Chief Brown, of the Department of Public Safety, a force of thirty men cleared the ground, but he refused to do more than preserve order. The pole raisers gave over for the time being, but shortly before noon resumed the offensive, and the police were again summoned. A parley was held, and the dispute was compromised by the placing of the objectionable pole alongside the telegraph pole at the corner, some ten feet from the place originally selected. The poles are intended for the proposed electric motor line.

THE TELEPHONE.

The telephone building in Wahoo, Neb., was destroyed by lightning and fire recently.

During the storm of May 9th in Minneapolis some of the electric light wires strung on the poles at the corner of Fourth and Jackson streets and the corner of Fourth and Minnesota streets were crossed with the telephone wires, and caused considerable havoc. The electric light current burnt out the telephone wires and set fire to the poles. Some of the firemen from the central fire hall were sent for, and quickly put out the fire, but it will be some days before the damage to the telephone wires can be repaired, as there were nearly 400 of them damaged, and there are about 200 telephones rendered useless. A large force of men were set at work on the poles and lines, but they are in very bad shape, and some instruments were totally ruined.

It seems almost incredible that a person in Philadelphia should hear a band of music playing in New York city, the ringing of her church bells, the whistles of steamboats, and the shouts of the populace in the streets as the civic and military processions passed by, and yet this was the experience of a lady in the Quaker city during the Centennial celebration. She takes press news over the long distance telephone, and, in order to facilitate matters and aid in hearing distinctly the dictation of the news sender at the other end, she wears a metal cap, attached to which is a receiver that presses close to her left ear. On Monday, during the naval pageant that welcomed the arrival of the president, she distinctly heard the whistles of the steam craft, the roar of the artillery, and the chime of Trinity's bells. On Tuesday, during the progress of the military procession, strains of music from the various bands and the shouts and hurrahs of the witnessing crowds were plainly borne to her ears. These phenomena were repeated Wednesday during the passage of the civic parade.

THE TELEGRAPH.

Telegraph lines were reported down in Minnesota last week, owing to the heavy wind storm. Only one wire was working between Duluth and Eastern points Tuesday night.

In an opinion handed down by Judge Simonton at Harrisburg, Pa., May 6th, he decides that the Western Union Telegraph company has no right to remove its case to the Circuit court of the United States. He holds that as it is brought to enforce a forfeiture for violation of state laws, it is not a suit of a civil nature. He therefore retains jurisdiction of the case, and refuses to permit it to be removed from his court.

Last week's storm did considerable damage throughout the country to telegraph and telephone wires. The Western Union suffered greatly, especially between New York and Boston and New York and Washington. Something like 10 out of 100 wires between New York and Washington were uninjured, and about 5 out of 100 between New York and Boston. The telegraphic service between Washington, Philadelphia and Baltimore was affected.

The police telegraph companies of the country are having a lively fight at Rochester, N. Y., where the Gamewell company secured a footing a couple of years ago. The Gamewell system has given satisfaction and has worked admirably, but when the question of enlarging the plant was considered, there was spirited opposition. The Municipal Signal company of Boston and the Gaynor Electric company of Louisville, Ky., underbid the Gamewell company, but as the difference was only slight and the introduction of a new system in connection with that now in operation might decrease the efficiency of the working of the department, it is probable the contract will be awarded to the Gamewell company.

A dispatch from Birmingham, Ala., gives the following account of the successful scheme of wire tappers: "The Western Union office is on the first floor of a four-story building. There is a basement under the office, and through this all wires enter the room above. Some one had attached a fine wire to the Western Union wires in the basement, run it through the outer wall, thence to the roof, then down a chimney to a vacant room on the fourth [illegible]

Miscellaneous Notes.

[illegible]

Senator [illegible] of Canandaigua, N. Y., [illegible] the cause of the Hamilton bill in the [illegible] legislature, and said the objection to utilizing the pow[illegible] Niagara for electrical development was based on "driveling sentimentality." This aroused the press of the state, and they poured hot shot into the senate until they succeeded in knocking out the bill. Discussing this scheme the Buffalo *[illegible]* said: "But we have met very few [illegible] who favor the Hamilton bill. In that case [illegible] the stalking horse for a company of outside speculators. We are glad that the Hamilton bill received a set-back in the senate on Tuesday night, and hope it will never be brought forward again." The Rochester *[illegible]* quotes this expression approvingly, and adds: "That is the prevailing sentiment of the state. There ought to be some way to put the Niagara reservation forever beyond the predatory operations of legislative Phillistines, even if the state has to take the trouble to pass a constitutional amendment on the subject."

A Minneapolis newspaper has been securing the experiences of residents of Dakota during the recent storms. A gentleman living near Huron is responsible for the following: "The stoves in the houses were so charged with electricity that one could hardly endure the shock that came from contact with them. If you touched your finger to a chandelier a spark came from it with a cracking noise. Electrical phenomena of a remarkable character were reported on all sides. The air was full of it. A gentleman, who lives near Huron, told me that a barbed wire fence on his farm became so charged with electricity that one day when the wire broke, and one end struck the dry grass on the ground, the grass at once took fire. I do not vouch for this, and it hardly seems possible, but it was told to me for fact. A representative of the *Scientific American*, studying the nature of the winds at Huron, and the electrical phenomena which accompanied them, advanced the idea that the atmosphere was so charged with electricity that it only lacked two or three degrees of producing spontaneous combustion. All over the territory, however near the truth may be, I know that there was enough electricity in the air to help along the fires that were burning there some weeks ago."

The following paragraph is taken from a St. Paul paper: Mr. Hillman, the chief stenographer of the District court, made his first experiments yesterday with the phonograph, which he is contemplating introducing as a feature of court reporting. In the afternoon he talked and sang to the wonderful machine, and his songs and remarks were repeated to an admiring audience with thorough precision, even the intonations and the quality of his voice being exactly reproduced. Last evening Mr. Hillman took the machine home with him and entertained quite a large audience of friends with it. Not only was conversation poured into it, but Mr. Hillman's daughter played the piano into it; two of the guests' boys treated it to a cornet and tenor horn duet, and Mr. Hillman and one of the other gentlemen stood before the mouthpiece and sang a duet. All of these performances were accurately repeated by the instrument, and in the duets both parts were distinguishable. Mr. Hillman in his court work proposes to dictate his notes of testimony to the phonograph, and thus, while he is busy in court taking more notes, the phonograph will dictate the testimony back to a typewriter, who will pound it out on his machine. He has not made any practical experiment in that matter yet, but feels quite confident that the phonograph is capable of performing all that is required of it in this line, provided it is properly managed. He discovered yesterday that, with the exception of some stenographers in Washington, he is the first to take a phonograph with this purpose in view.

Personal Paragraphs.

George Cutter of Chicago has returned from his eastern trip.

Frank B. Pond of the Pond Engineering company was in Chicago last week.

H. F. Lutkin of the C. & C. Motor company of New York, was in Chicago last week.

P. C. Ackerman of the American Electrical Works of Providence, R. I., was in Chicago last week.

C. H. Jackson of the Standard Underground Cable company of Pittsburg, was in Chicago last week.

T. P. Conant of the Electrical Accumulator company, Chicago, returned to Chicago last week after a three weeks visit in Detroit.

Business Mention.

F. E. Degenhardt, Chicago manager of the Standard Underground Cable company sold two and a half tons of wire last week for the electric light plant to be installed at Traverse City, Mich. He also sold an order for No. 22

B. & S. to the Central Union Telephone company for use at Springfield, Ill. All the wire used by the Springfield exchange is of Standard make.

W. H. Wissing has opened the western office for the Wings fans at the corner of Lake and Dearborn streets, Chicago. The fans, which are manufactured by the Simonds Manufacturing company of New York, are having an extensive sale.

An illustrated catalogue of electrical gas lighting apparatus has been issued by A. L. Bogart of New York, and it is certainly an interesting pamphlet, showing, as it does, the advancement that has been made in this line. But this catalogue also contains much valuable information, and fully explains the operation of the numerous devices used in this line.

The proprietors of the Knapp Electrical works state that the white-core wire lately furnished to the Colonnade hotel in Philadelphia, has behaved so nicely that the hotel people have written offering their congratulations upon the exceedingly good results shown. The Knapp Electrical works are the agents for this wire, which is manufactured by the New York Insulated Wire company, and are selling large quantities of it throughout the west. It may be added that the Knapp Electrical works are doing an excellent business in all departments. Their factory facilities are being extended constantly. A year or so ago this concern was in rather limited quarters on Randolph street, Chicago. To day they occupy entirely a large four-story and basement building on Franklin street, and do not find their present quarters at all too large for their requirements. Besides being general supply dealers, they pay particular attention to special manufacturing, and taking everything together, their business now is assuming handsome proportions.

Telephone Stock Quotations.

Col. S. G. Lynch, broker, 146 LaSalle street, Chicago, reports the following quotations of telephone stocks:

Chicago	300	305
Central Union	49	50
Michigan	80	81
Great Southern	31	33
Colorado	39	40
Rocky Mountain Bell	40	41
Cumberland	67	69
Wisconsin	116	117
Bell of Missouri	150	153
Iowa Union	22	25
Missouri and Kansas	65	67

Electrical Patents.

Issued May 7, 1889.

402,562. Electric Signaling Apparatus. John P. Coleman, Swissvale, Pa.

402,563. Method of Treating Underground Electrical Conduits with Chemical Substances. Arthur E. Colgate, New York, N. Y.

By means of an atomizer placed in the conduit and drawn through the same, sulphuric acid is scattered therein in such manner that all crevices and pores in the wood may be penetrated.

The first claim reads: "The process of treating the electric conduits with a chemical substance, which consists in throwing the same against the interior of the conduit in the form of a spray."

402,565. Conduit for Electric Wires. George W. Cook, Detroit, Mich.

402,586. Distribution of Electricity by Secondary Batteries. William W. Griscom, Haverford College, Pa.

The invention relates to the construction and arrangement of apparatus for automatically including and excluding a secondary battery with respect to the charging circuit, depending for its action or control upon the state or condition of the battery as regards its charge. The last claim is given:

"7. The combination of a charging circuit containing a suitable source of electricity, a secondary battery, an artificial resistance in amount equal to the effect produced by the counter electromotive force and resistance of said battery, and a switching device for inserting and withdrawing said battery and said resistance with respect to the charging circuit, successively."

402,592. Electric Wire Insulator. Arthur W. Heaviside, Newcastle-upon-Tyne, England.

402,613. Electric Bell. William K. Rainey, New Orleans, La.

402,620. Electric Annunciator. Benjamin Smead, Chicago, Ill.

Claim 2 is given: [illegible] forming one terminal of [illegible] magnet, and engaging [illegible], and on its further [illegible] and engaging the [illegible] a bell magnet."

[illegible] Wilson, Boston, [illegible]

[illegible] John [illegible]

[illegible] provide an auto[illegible] [illegible] patrol [illegible]

[illegible] of an [illegible] operating [illegible] annunciator in the circuit at the patrol station, and a shunt around said annunciator coils closed by the falling of the shutter."

402,671. System of Electrical Distribution and Conversion. Thomas H. Hicks, Detroit, Mich.

The claim reads:

"In a system of electrical distribution and conversion, the combination of a source of high tension intermittent electrical impulses of one direction, a main circuit connected thereto, a derived local circuit containing translating devices, and a reaction coil having all or a portion of its helices in the main circuit and a portion in the local circuit, both portions being in the same magnetic field."

402,683. Sign. Charles E. Manning, Waverly, N. Y.

402,684. Magnetic Separator. Hiram S. Maxim, London, England.

The chief peculiarity of the invention consists in the employment of moving magnetic fields for the separation of gold, silver, copper and other metals from non-metallic substances.

Of the nine claims we give the first:

"In an apparatus for separating metals and non-metallic substances, the combination, with approximating magnets or magnetic poles adapted to maintain intermediate fields of force, of a hopper or receptacle from which the material under treatment passes freely through said fields of force and means for producing rapid reversals or alternations of the polarity of the fields or lines of force through which the material is passing."

402,717. Telegraph Instrument. Charles G. Burke, Richmond Hill, N. Y.

The instrument described is a sensitive telegraphic receiver suitable for cables or other lines where feeble electric currents are used.

The claim is:

"The combination of a solenoid, two magnets applied to the respective ends thereof, a pole of one magnet being partially within the solenoid at one end and the other pole of said magnet partially surrounding the same end of such solenoid, the poles of the other magnet being similarly arranged within and without the other end of the solenoid, but in reverse order of polarity."

402,752. Insulator. Frederick M. Locke, Victor and John Lapp, Honeoye Falls, N. Y.

402,753. Cut out. Osborn P. Loomis, Somerville, Mass.

The invention consists of a conductor located near the filament or near the leading-in wires, which conductor is connected at one end to one of the line terminals, and has in connection with it a fusible wire, which controls safety devices to cut the lamp out of circuit when the filament becomes impaired. When the filament is so impaired, the current is diverted from the circuit to the aforesaid conductor, causing the fusible wire to melt, and allowing the cut-out to operate.

402,754. Automatic Circuit-Controller for Electric Lights. Osborn P. Loomis, Somerville, Mass.

402,756. Sign. Charles E. Manning, Waverly, N. Y.

402,779. Electrically Controlled Apparatus for Treating Emphysema. Alexander Steinhoff, Briesnitz, near Dresden, Saxony, Germany.

402,810. Supporting and Cross-Connecting Electric Wires. William J. Denver, Boston, Mass.

402,823. Electric Clock. Emil G. Hammer, Brooklyn, N. Y.

Of the fifteen claims the third is appended:

"In a clock work mechanism, the combination, with an escape wheel, its motor, and a vibrating anchor for controlling its movement, of a sliding staff and an impulse-tooth carried thereby and arranged to be successively engaged and lifted by the teeth of said escape-wheel."

402,828. Circuit Closer for Railway Car Telegraphs. George I. Hopkins, Manchester, N. H.

402,829. Coupler for Electric Conductors. George I. Hopkins, Manchester, N. H.

402,832. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa. The first and eighth claims are given:

"1. The combination of two tracks sloping downward and away from each other, with a slotted conduit arranged between them at the highest part, and one or more electrical conductors arranged within the conduit.

"8. The combination of two railway tracks, a slotted conduit arranged between them and mechanically connected to the said tracks, and one or more electric conductors within the conduit."

402,836. Insulator and Holder for Electric Railways. Byron Jennings, San Jose, Cal.

402,890. Electric or Cable Railway Car. Sumner A. Bemis, Springfield, and Louis Pfingst, Boston, Mass.

402,904. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

The conveying aprons run in the same direction, and are placed one above the other. These are used in connection with a series of transverse aprons and magnets located in proximity to each of the transverse aprons, the aprons being driven by suitable mechanism.

402,912. [illegible] Joseph B. Entrikin, Des Moines, Iowa.

402,915. Portable Galvanic Battery. Albert Friedlander, Berlin, Germany.

402,929. Telephone System. Fred A. Holcomb, Grand Rapids, Mich.

The first and seventh claims read: "1. The combination, with a telephone system, of a recorder for recording a signal at a distant station and a device at the sender's station adapted to be operated by the sender for automatically recording at the distant station the number of the call of the sender.

"7. In a telephone system, the combination, with a device for recording signals, of a block of non-conducting material, a spring secured at one end thereto, a notched wheel upon which this spring is adapted to rest, and mechanism for throwing said spring into electrical circuit and for releasing the actuating mechanism of the notched wheel."

402,929. Telephone System. Fred A. Holcomb, Grand Rapids, Mich.

The third claim is given:—"In a telephone system, the combination, with a recording mechanism, of a make-and-break mechanism and a device for throwing the same into electrical circuit and at the same time setting free the recording mechanism."

402,960. Electric Bell. Richard B. Moffatt, New York, N. Y.

402,971. System of Linear Transformers. Elias E. Ries, Baltimore, Md.

The first claim is:—"A system of electrical distribution and conversion, consisting of line conductors extending from the generating station to the farthest point of consumption, charged by intermittent or alternating currents of high tension, one or more sections of conductors parallel and in inductive proximity to the line conductors, and one or more working circuits bridging said conductors at any desired point or points."

402,986. Electric System of Communication. Ebenezer B. Shafer, New York, N. Y.

The system comprehends the sending of the call or notification by one instrument and the message by a separate instrument, the signals or characters of which are distinguishable from each other, using either simple numbers or characters or combinations of them, according as the call or notification message demands, the call being sent first by preference, after which the message follows without repetition of the call or notification; but of course the call may be sent after the message, if desired.

402,990. Commutator Brush Controller for Electric Motors. William L. Silvey, Lima, Ohio.

The invention relates to the peculiar devices for holding the brushes on an electric machine, by which it is possible to change the direction of revolution in the armature by changing the point of contact on the commutator. This is accomplished in this device by employing four brushes, and raising one set of brushes and depressing the other.

403,009. Slotted Conduit for Electric Conductors. Charles J. Van Depoele, Chicago, Ill.

403,010. Electric Connection for Railway Rails. Charles J. Van Depoele, Chicago, Ill.

403,011. Electric Locomotive. Charles J. Van Depoele, Chicago, Ill.

Claim 3 reads as follows: "An electric locomotive comprising a car or platform, a single pair of centrally located driving wheels, the motor located above the driving wheels, an elongated box or bearing upon the driving axle and supports extending between the said box and the frame of the motor."

403,017. Automatic Governor for Electric Motors or Dynamo-Electric Machines. Schuyler S. Wheeler, New York, N. Y.

The primary object of the invention is the maintenance of a constant speed in spite of variations in the load, current, and other conditions which occur in practice.

The first and eleventh claims are appended:—"1. In an electric motor or dynamo electric machine, the combination, with the pole pieces and the armature which are constructed to have their positions changed with respect to each other, of a dummy armature or magnetic substitute for the armature.

"11. In an electric motor or dynamo electric machine, the combination, with the armature, of a supplementary or dummy core of greater magnetic strength or capacity than the armature itself."

403,018. Field Magnet for Dynamos. Schuyler S. Wheeler, New York, N. Y.

Claim 1 is as follows: "A field magnet for electric motors or dynamos, made in the general form of a triangle, with a core at the vertex capable of being freely wound through the armature space and cores near the base at the two sides and placed at an angle to each other, so as to be freely wound without interference."

REISSUE.

11,002. Electric Arc Lamp. Clarence B. Noble, Cleveland, Ohio. Original 374,129, dated Nov. 29, 1887. Application for reissue filed Feb. 15, 1889.

The invention relates to automatically throwing the current from one set of carbons to another when the former have been nearly or quite consumed.

Claims 3 and 5 follow.—"3. In an electric lamp, a slotted core for the main and shunt magnets, a slotted block sliding within the slot in the core, a pin passing through the core and a slot in said block, an arm connected with said pin, and a pair of contacts adapted to be brought together by the movement of said arm, the said contacts completing a circuit to cut out the lamp.

"5. In an electric arc lamp in which two sets of carbons are burned successively, the combination of arc establishing and regulating magnets, a core movable therein, clutches, an arm actuated by the movable core, and extending beneath the clutches, and a device engaging both clutches for holding them one at a time, out of the way of the arm when the latter moves up to establish the arc."

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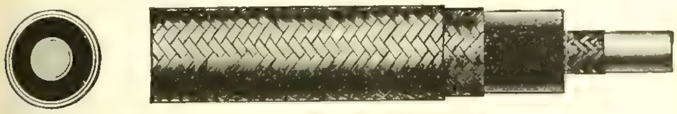

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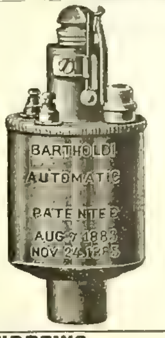

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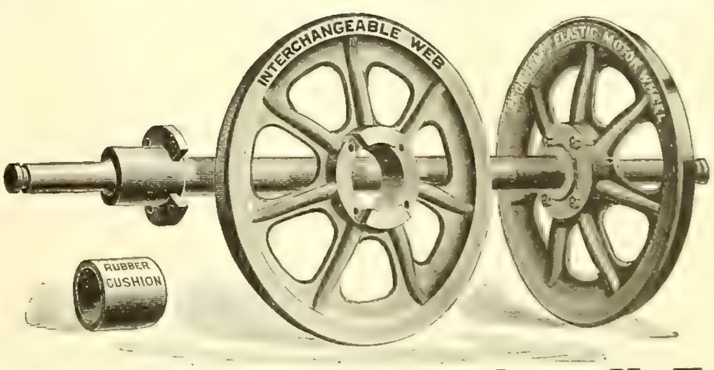

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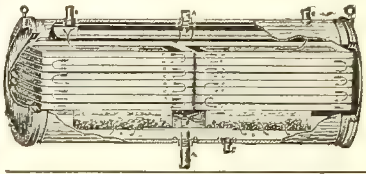

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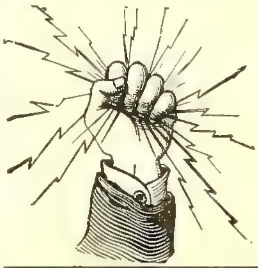

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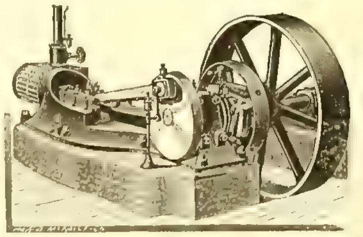

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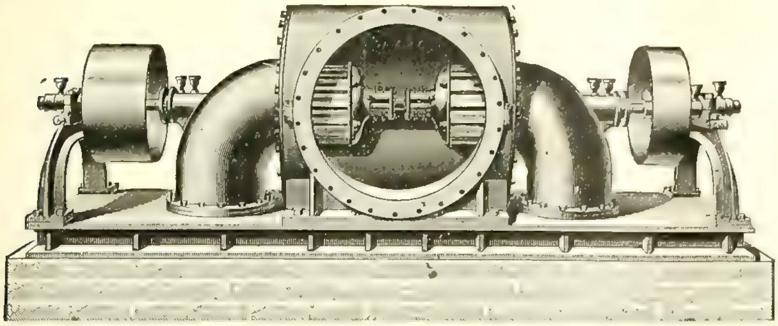

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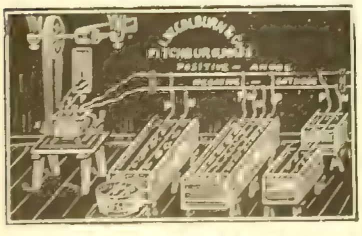

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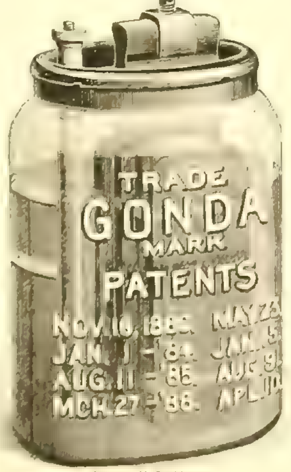

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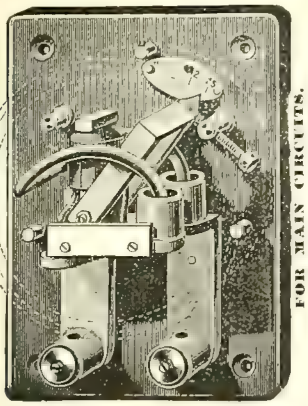

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The 3-Wire System.

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b. In a Completed Building.

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Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simply a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

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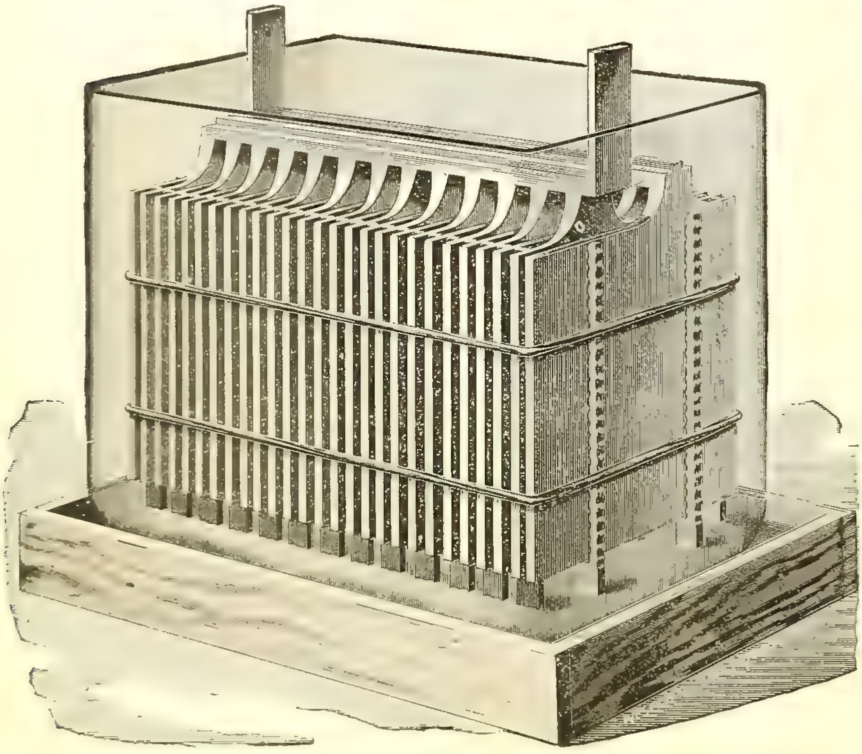

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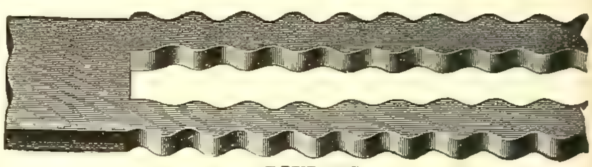

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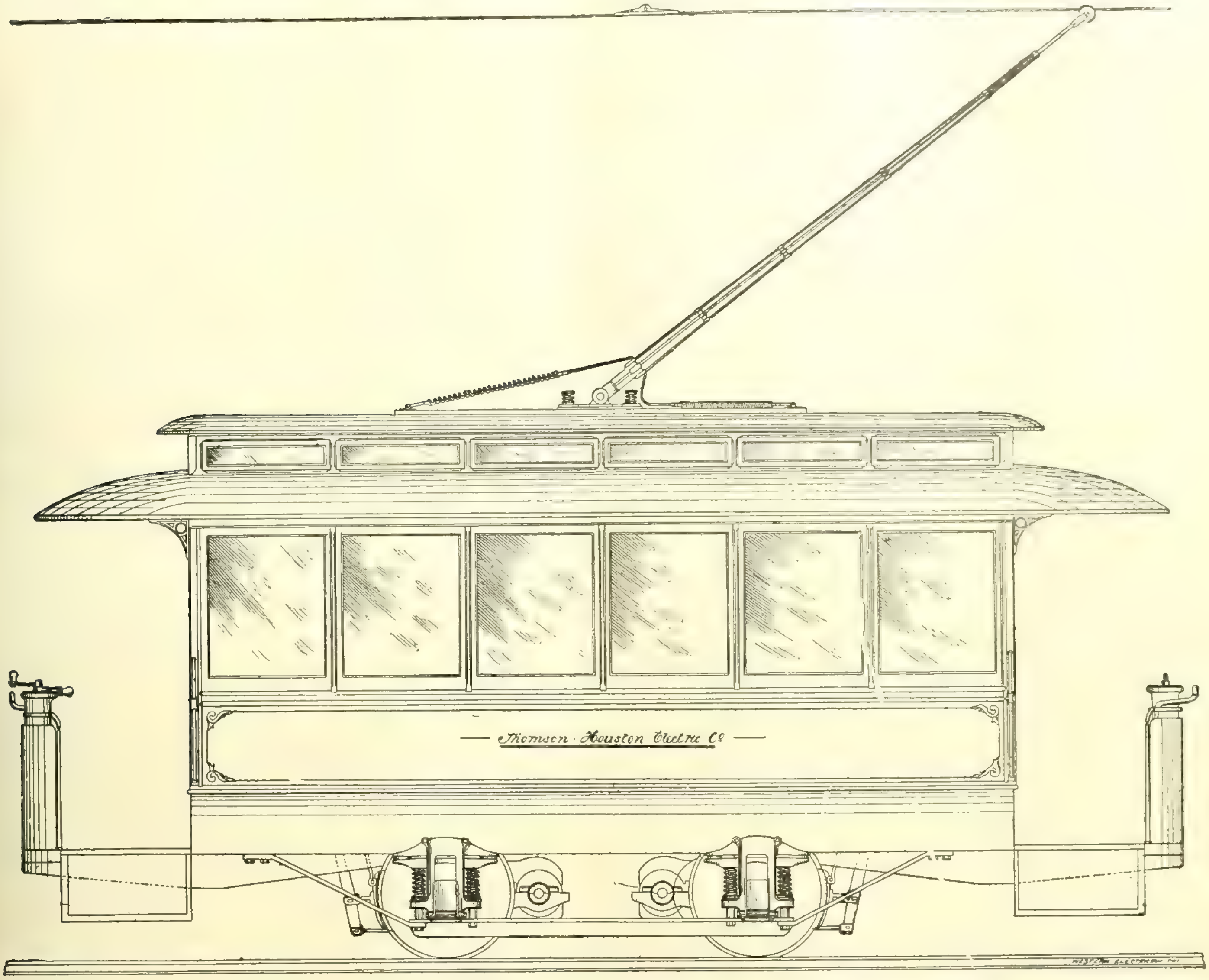

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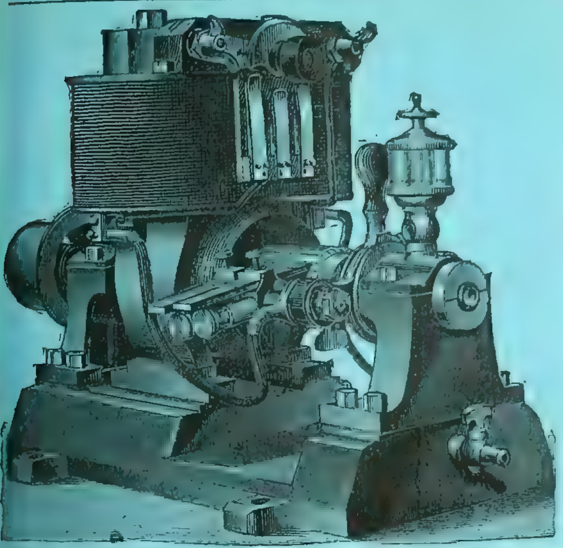

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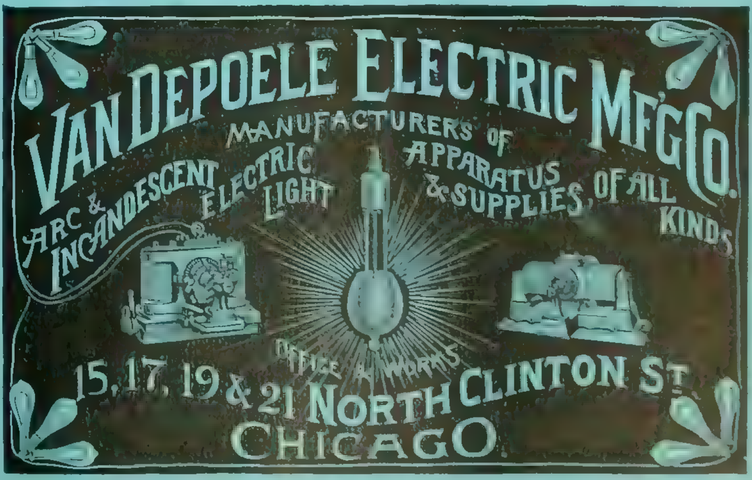

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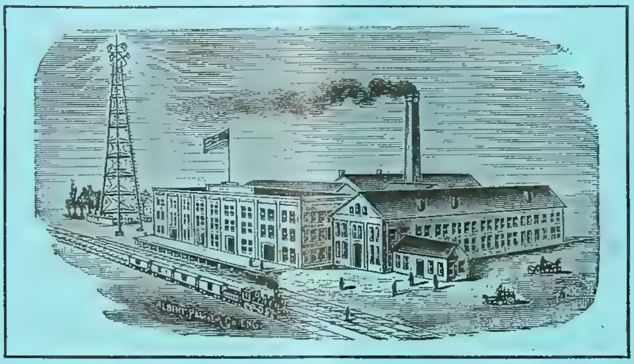

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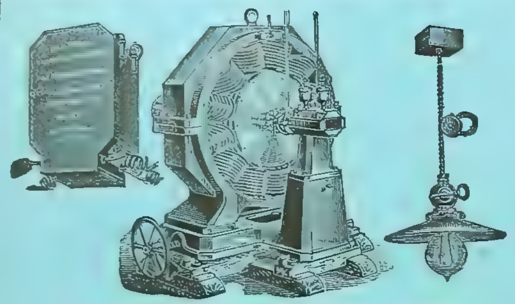

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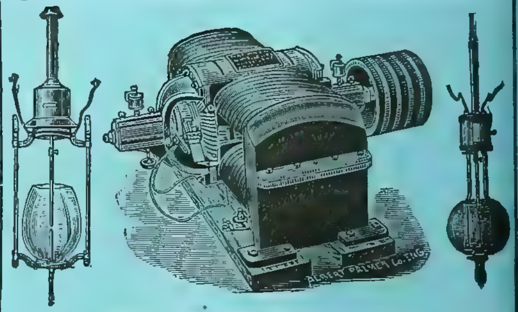

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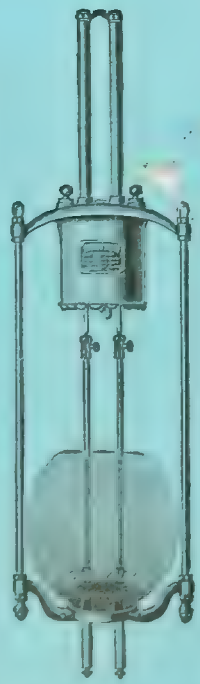

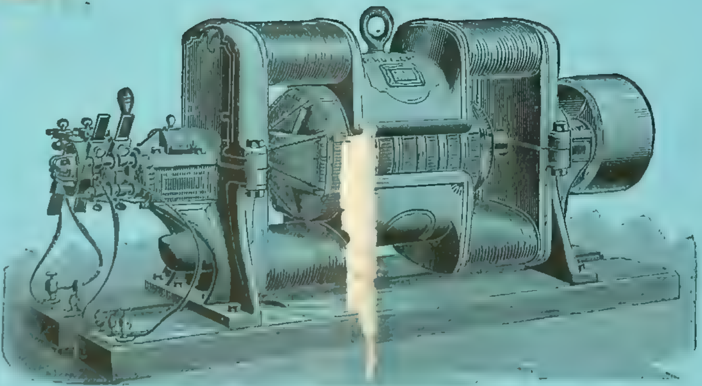

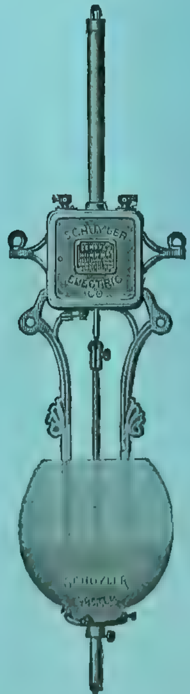

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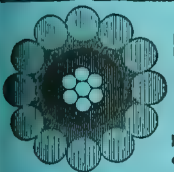

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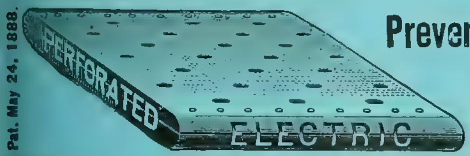

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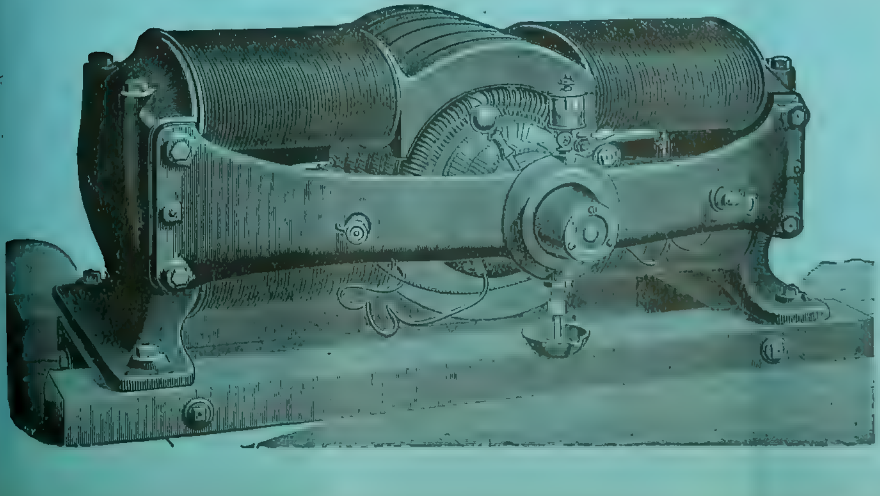

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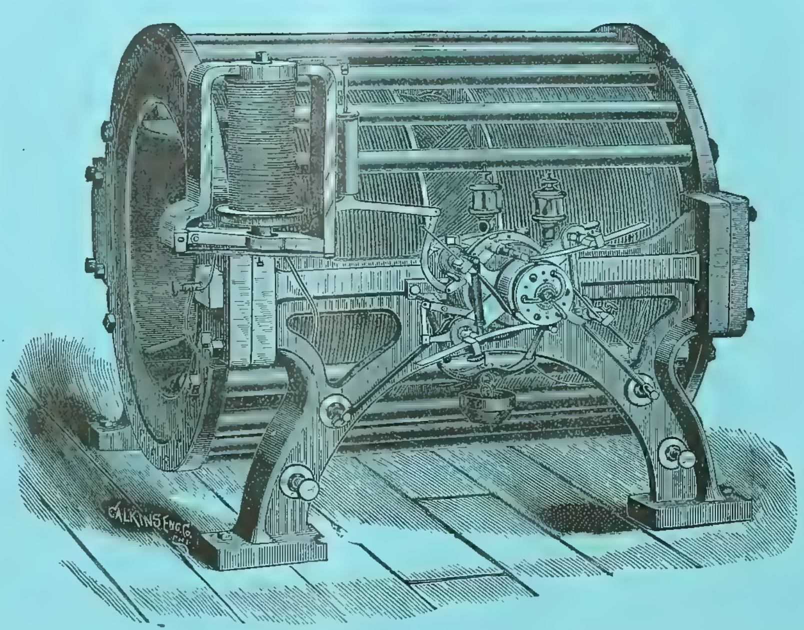

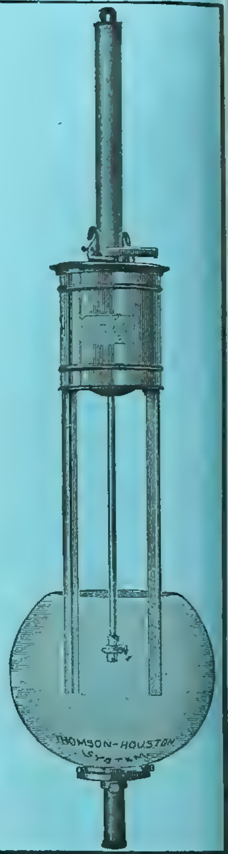

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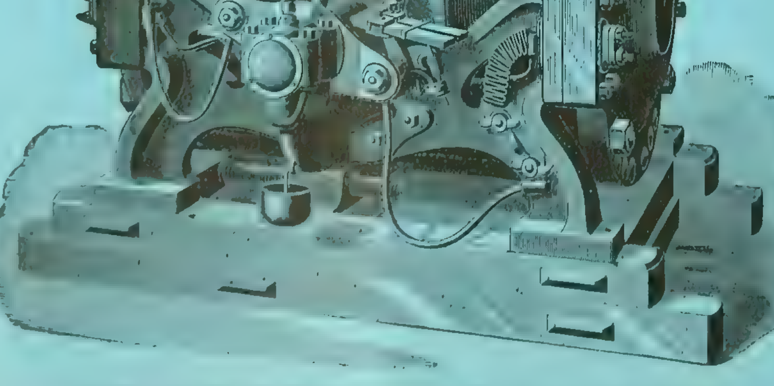

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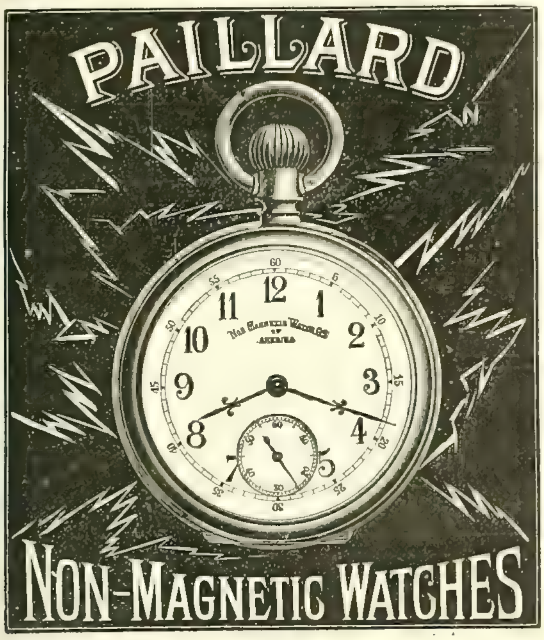

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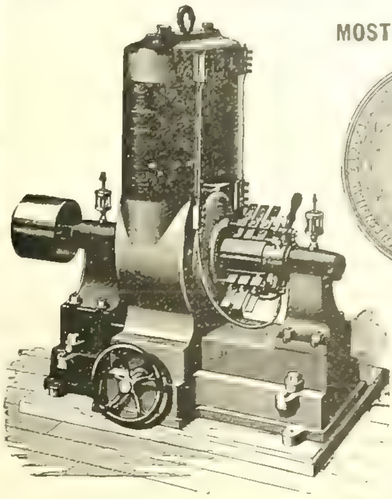

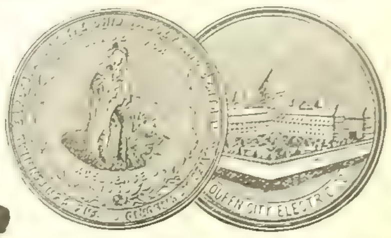

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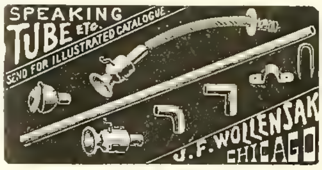

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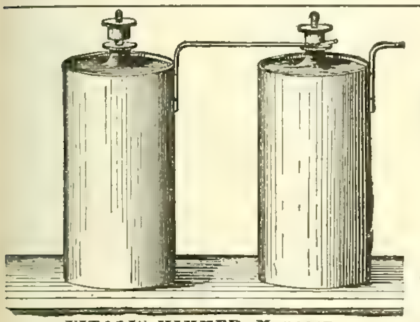

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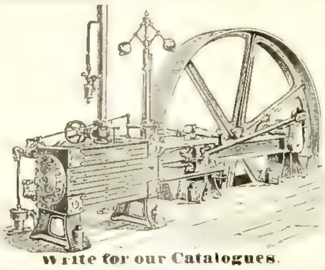

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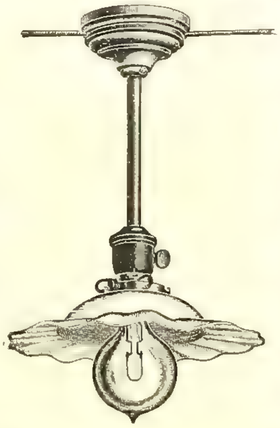

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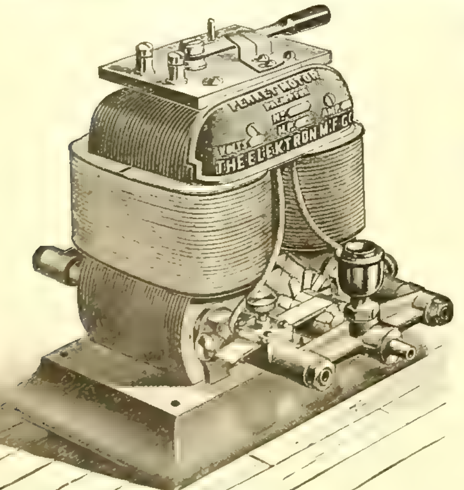

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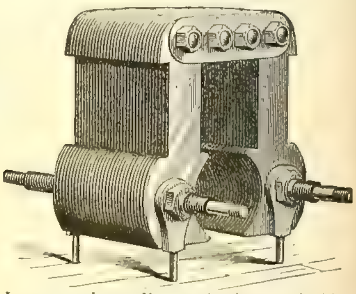

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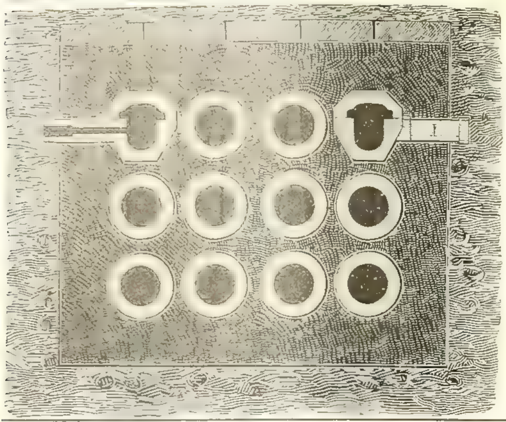

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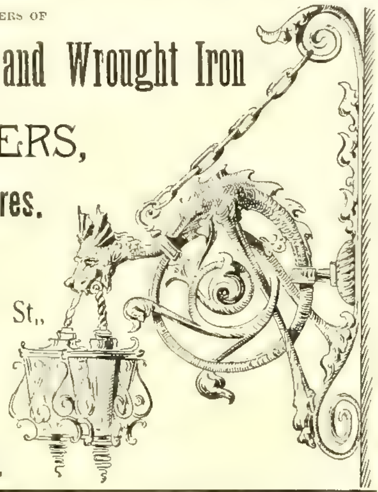

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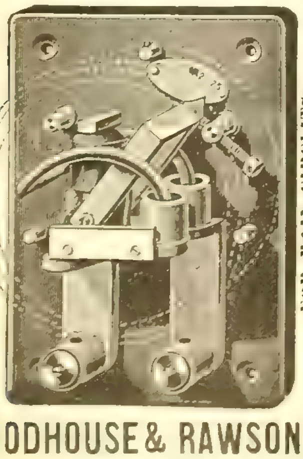

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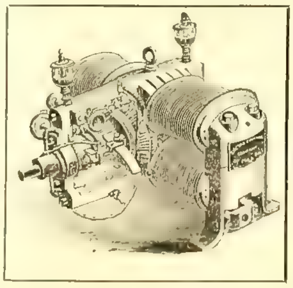

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EVERY SATURDAY.

Vol. IV. CHICAGO, MAY 25, 1889. No. 21

Ganz & Co.'s Alternate Current Motor and New Dynamo.

The statement made a few months ago that Ganz & Co. of Budapest, Austria, were perfecting an alternating current motor excited unusual attention. The demand for a machine of this kind is so pronounced that the limited descriptions which were published proved extremely unsatisfactory. The motor is now claimed to be commercially successful. The details of the machine the inventors are not yet ready to disclose, but a cut of the motor is herewith presented, which shows its general appearance.

An installation at Wiener-Neustadt is of special interest, as at this place has been made the first application of the Zipernowski-Blathy-Deri long distance system, with transformers for the distribution of electricity for light and power. A water power of 80 horse power is used to drive the primary generator, which is the latest type made by Ganz & Co. Its output is 25 amperes and 2,000 volts at 500 revolutions per minute. The current is utilized in supplying 200 incandescent lamps and three alternating current motors for the brewery in Wiener-Neustadt. Two of the motors are of 10 horse power and the other of 5 horse power. The former make 830 revolutions per minute, and the smaller motor makes 1250 revolutions per minute. The distance between the generating station and the distributing point is about 2,500 meters. As the first practical employment of alternating current motors, the installation has already attracted great attention. The print from which the accompanying wood cut was made was sent to the Western Electrician by Ganz & Co.

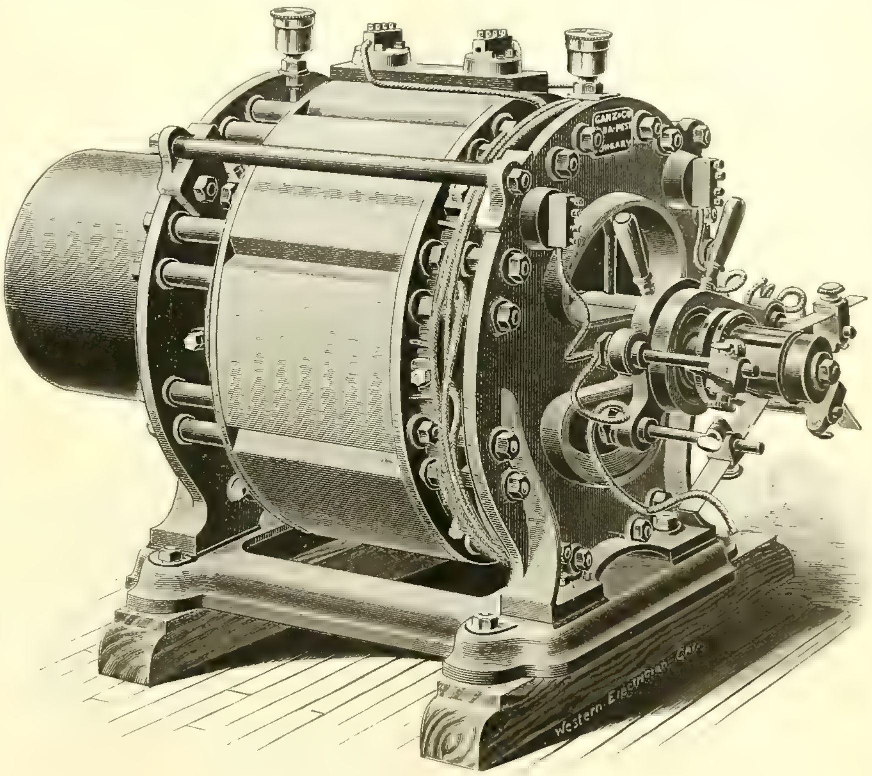


FIG. 1. THE GANZ NEW ALTERNATING CURRENT MOTOR.

Ganz & Co. have recently made several interesting power transmission installations with their continuous system. One of these is at Wattenser. The water power of the Wattenser brook is utilized by means of a turbine wheel which is employed to operate the generator. The current at 500 volts' pressure is conducted to a paper mill by means of overhead bare copper wires, and operates an electric motor of 50 actual horse power.

Another interesting installation is that at Ober-Turtschek, near Kremnitz. Fifty incandescent lamps, two arc lights and a motor in a lumber mill receive their supply of current from a continuous current dynamo which is operated by water power. The motor which is stationary, is of 3½ actual horse power. It is used to pull small cars loaded with lumber up an inclined plane to the railway station. The incline is about 1,000 feet in length. The cars are attached to a wire rope which runs over a drum. The drum is attached to the motor by a worm gear. The Zipernowski-Deri alternate and continuous current systems have both been illustrated and described in the present volume of the Western Electrician, the former in No. 3, and the latter in No. 9. The cuts of the latest form of the alternate current dynamo presented herewith are reproduced from *Industries* of London. In earlier forms of the machine, star-shaped field magnets of non-laminated iron, were employed, and revolved in a cylindrical armature, the core of which was composed of thin ring-shaped iron plates held in a frame. The armature coils were flat bobbins laid upon the inner surface of the armature core side by side. The magnetic resistance of the interpolar spaces was high, and to overcome this the later machines have armature cores with a series of internal Pacinotti projections which form the cores of the armature bobbins. To avoid the heating of the pole pieces, the field magnets are now built of *U*-shaped iron plates *F*, as shown in Fig. 4. These plates are laid upon each other, and arranged round the spindle so as to form a star, alternate layers being arranged to break joint, as shown by the dotted lines. The plates are fastened together by insulated bolts *B*, and the existing coils are wound upon separate formers, slipped over the magnet cores, and held in position by bobbin holders and screws strong enough to resist the action of centrifugal force. The armature core, which formerly was continuous, is in the new machines subdivided into a number of *T*-shaped sections, the central stem of the *T* forming the Pacinotti projection, *A* being very short, and of equal width and length with the magnet. These sections are so arranged that each with its armature bobbin can be removed without disturbing the rest of the machine. Fig. 4 shows the construction of the armature sections, and the manner of supporting them. The frame of the machine consists of two ring-shaped castings held together by strong bolts, and in addition, there are iron traversers to which the segments are bolted. The armature plates are held together by ribbed bronze plates, which also serve to hold the armature coil in its place. In larger armatures bronze plates are also inserted at intermediate points, and they serve for the attachment of the armature section to the traversers by means of insulated bolts and nuts. Figs. 2 and 3 show a complete machine intended for an output of 80 kilo-watts. In this machine there are fourteen poles and fourteen armature sections, which can be coupled to give a pressure of either 2000 or 4000 volts with a current of respectively 20 or 40 amperes. The speed of the machine is 360 revolutions per minute, giving 5040 reversals, or a frequency of 42. The total weight of the iron core, both in field magnets and armature, is 1 ton 7 cwt., and the total weight of copper is 930 lbs. The resistance of the armature is 1.038 ohms for a 2000 volt machine, giving a loss of 2.08 per cent. by ohmic resistance in the armature circuit. The resistance of the field magnet circuit is 3.24 ohms, and a current of 28.7 amperes is required at full output, entailing a loss of 3.33 per cent. for excitation. It is stated that the total commercial efficiency, including the power required to excite the machine, is at full output 87 per cent.; and this figure is somewhat increased when the machine is direct driven by a steam engine. In order to facilitate the cleaning of the armature coils, the frame of the armature has been arranged in such a way that it can be shifted longitudinally beyond the space occupied by the field magnets, so as to expose the whole of the internal surface, and make it easily accessible both for cleaning and for the renewal of a coil, should it have been damaged. In the new type of machine, the armature itself is, however, kept fixed, and the magnet wheel is arranged to slide longitudinally, for which purpose one of the standards is fitted similarly to the slide rest of a lathe. Fig. 2 shows the machine in working condition with the magnet wheel in its place, while Fig. 3 shows the machine with the magnet wheel drawn out so as to expose the inner surface of the armature. In order to slide back the magnets, the pulley must be removed, and the standard on the opposite side can then be drawn back by means of a ratchet bar, screw and nut to its outermost position, as shown in Fig. 3.

Chicago Electric Club.

The Chicago Electric Club held its first meeting in its new quarters in the High building May 15th. The quarters are in every way adapted to the needs of the club. The club rooms comprise two floors, which are connected

by a private stairway. The assembly room, reading room and ladies' parlors are on the second floor of the building. On the third floor are located the billiard room, general dining room, card rooms and private dining rooms. The rooms havebeen handsomely decorated and furnished. Everything has a look of substantial elegance. One feature of the rooms is par-

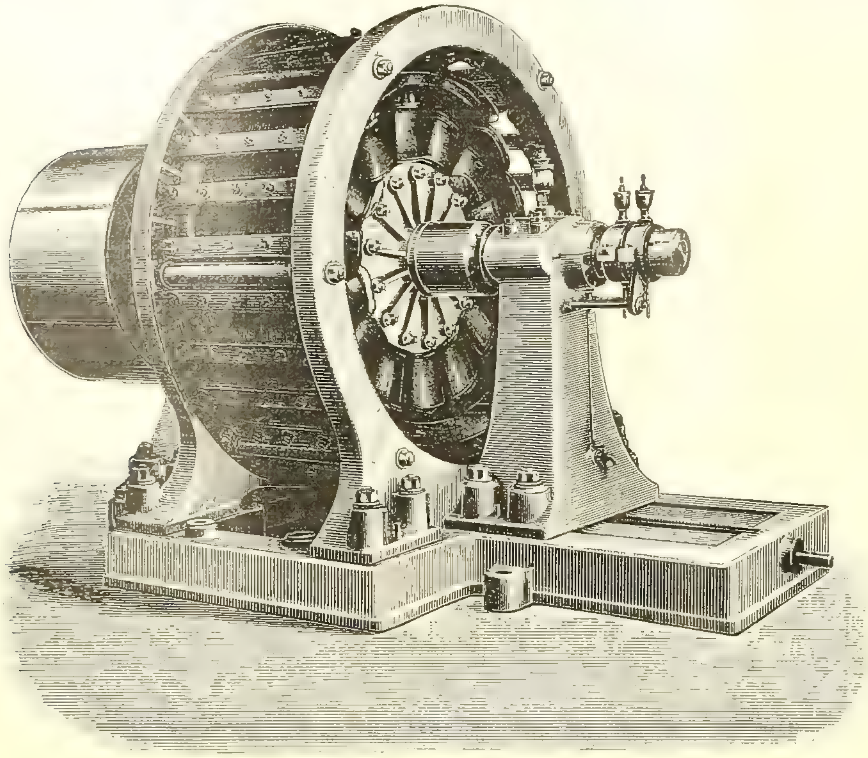
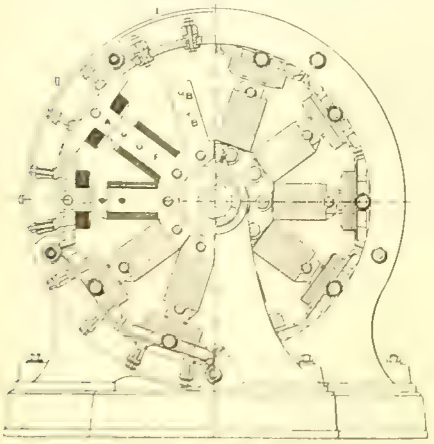


FIG. 2. THE GANZ ALTERNATING CURRENT DYNAMO.

ticularly gratifying to the members: The rooms are brilliantly lighted by incandescent lamps, and the effect is in striking contrast to the dim appearance of the former quarters, which were lighted by a poor quality of Chicago gas.

President S. A. Barton called the meeting to order, and stated that the session was held in order that the members might have an opportunity of seeing what the committees had done toward decorating and furnishing the rooms. After remarks by several members of the committee, President Barton said: "Your president is decidedly pleased with the effect which the



[illegible]

removal to the new quarters has had. The [illegible] when the question of [illegible] under discussion, [illegible] respond to [illegible] The voluntary [illegible] than we antici[illegible] coming in. The [illegible] assessment [illegible]

[illegible] It was decided to hold a [illegible] All details were [illegible] tainment.

Chicago City Electric Light Plant.

The work of extending the city electric light plant in Chicago will begin about June 1st. Prof. Barrett, city electrician of Chicago, has completed his plans, and the city council and mayor have approved them. It is the intention of the city electrician to establish a system that will eventually embrace the entire city. In pursuance of this plan the city has been divided into eleven districts, and a power house will be established in each of them at convenient points.

Prof. Barrett estimates that it will require about three years to complete this task. This year he expects to cover five new districts and enlarge the present plant—in fact, he has deemed it advisable to prepare for the establishment of a new power house in the place of the present station, and enlarge the capacity of the present plant. This will be known as the fourth district. It will include all the territory between Division street on the north, the river on the west and south, and the lake on the east. The capacity of this plant will be 1,000 lamps, and $60,000 will be expended this year in erecting a new power house and extending the plant. All the streets in this district, however, will not be lighted by electricity this year, but the plant will be so arranged that from time to time new streets can be cut in until all are supplied with electric lights.

The first district which will extend from the river to Sixteenth street and the lake will receive a large slice of the appropriation. Prof. Barrett expects to put $60,000 into this district. A new power house will be included in this estimate. The capacity of this plant will be 1,000 lights, but of course, that number will not be put up immediately. It has been decided to build the power house for this district on the south end of the Exposition company's lot between Michigan avenue and the lake.

The eighth district will also be the scene of ope ations this year. A plant will be established there for 700 lights. This district will extend from the river on the east to Ashland avenue on the west, and from Kinzie street on the south to North avenue on the north. During the present season $55,000 will be expended in this district.

The sixth district is west of the first, extending from the river to Ashland avenue, and from Kinzie street to Sixteenth. As this is an important part of the city, the plant installed there will have a capacity of 1,000 lights, and $55,000 will be expended on it this year.

The last district to be invaded will be the third, where lights are much needed. Neither gas nor oil is now used in this district. The territory included is bounded on the east by the south fork of the south branch, on the north and west by the canal, and on the south by the city limits. Three hundred lights will be put in here eventually.

In lighting business portions of the town the city electrician will not be governed entirely by the boundaries thus described, but a number of prominent thoroughfares that pass through these districts will be illuminated their entire length, or as far as practical. These streets include Archer avenue, Blue Island avenue, Harrison street, Twelfth street, Van Buren street, Madison street, Randolph street, Milwaukee avenue, Clybourn avenue, Clark street on the north side of the river, and State street on the south side. As soon as the lighting of the city by electricity becomes general, these streets will be cut off from the stations with which they will be connected this year, and included in their proper territories.

The work mapped out for this year includes

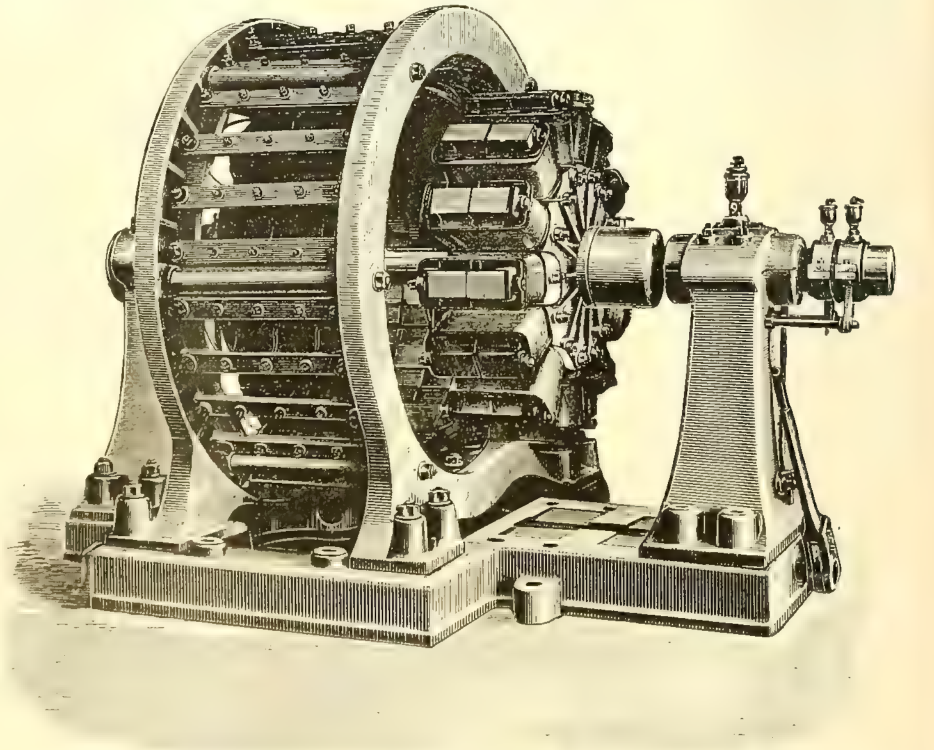
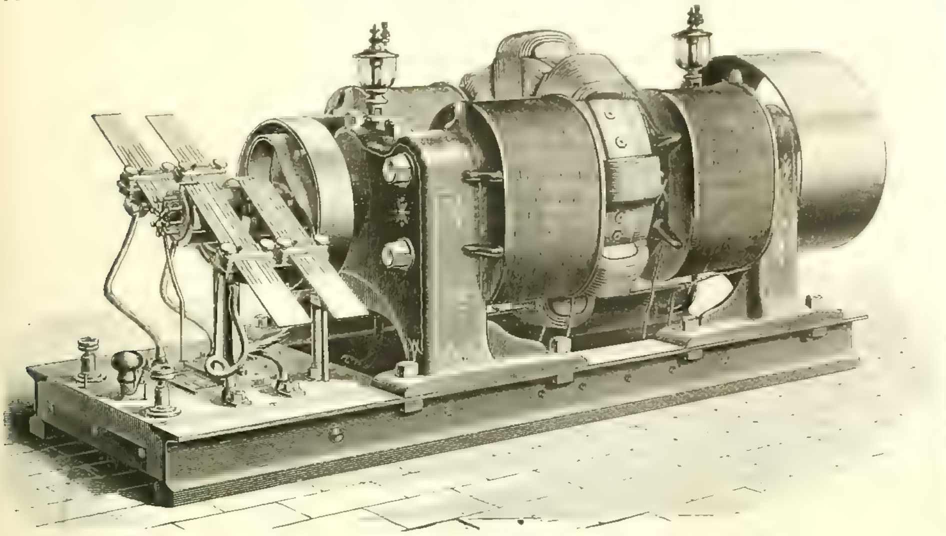


FIG. 3. THE GANZ ALTERNATING CURRENT DYNAMO.

the building of power houses in the districts named, and the construction of 200 miles of conduit to carry the wires. In the matter of power houses nothing will be spared to make them first-class in every respect. The best machinery obtainable will be secured, and of course the most approved types of dynamos, etc., will be introduced. Naturally a large item of expense will be the construction of the conduits, but this will not be proportional to the cost of the work done last year, as the excavation will not cost as much on the outskirts as in the center of the city. More lights can therefore be secured for the same amount of money than last year. The specifications for engines, conduits, lamp posts and power houses are about completed, and will be open for inspection at the City hall.

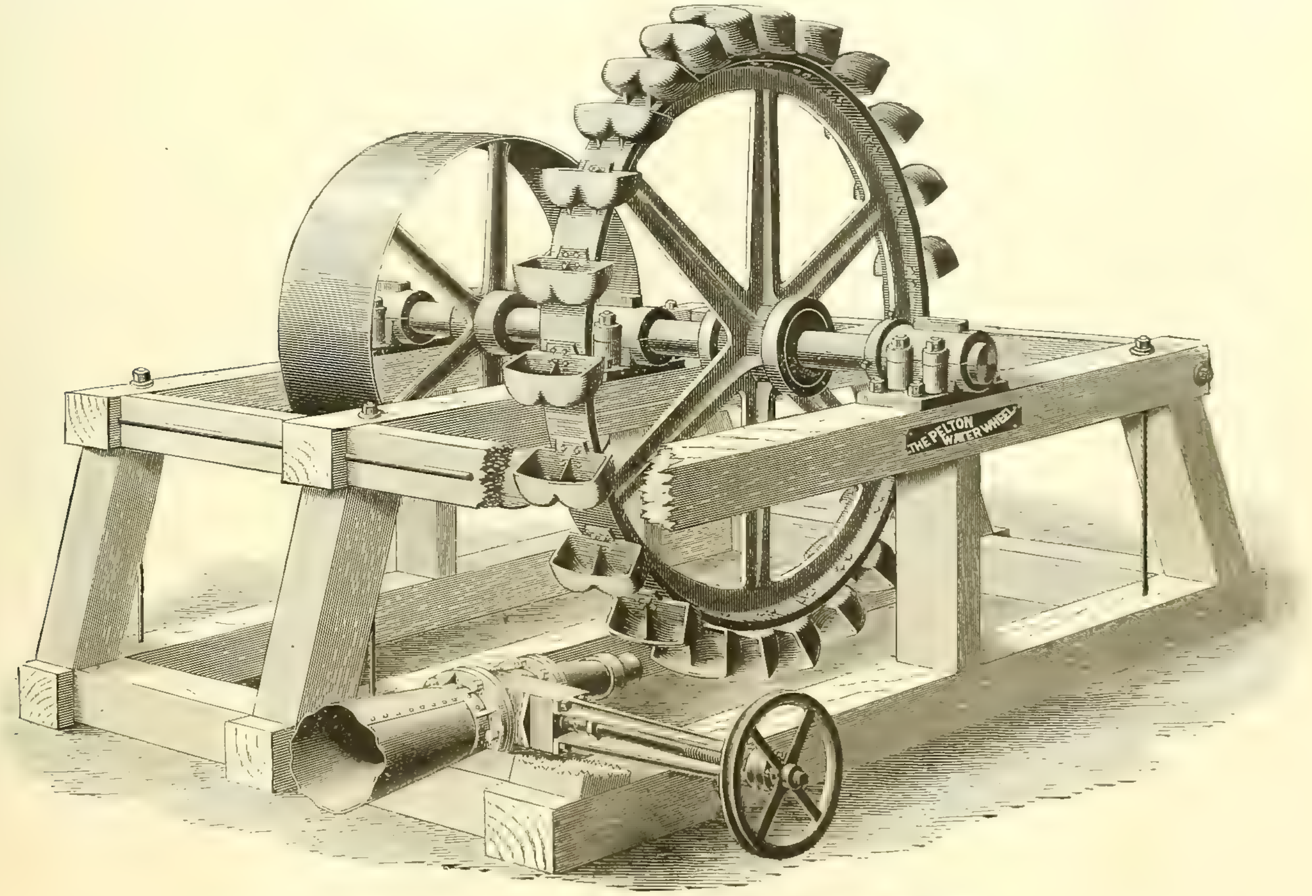

ELECTRIC POWER TRANSMISSION AT VIRGINIA CITY, NEV.—THE BRUSH MOTOR.

It is Prof. Barrett's intention to introduce high tension as well as low tension systems into the city plant. In the controversy with the electric light men, who opposed burying wires, he was confronted with the statement that he had no high tension system operating, and now he desires to show that he can operate high as well as low tension lines in his conduits. He is confident that he can successfully operate both systems, and he has no doubt that electric light companies controlling both systems will be ready to put in bids.

The work will be pushed as rapidly as possible, and should the weather permit, it is quite probable the present plans will be enlarged. At any rate, it is expected that 700 or 1,000 lamps will be in operation before January 1st.

Electrical Power Transmission at Virginia City, Nev.

"More power, economical power," has been now for several years the imperative demand of the owners of mining properties on the celebrated Comstock lode at Virginia City, Nev. The problem has been to work the enormous quantities of low-grade ore at a profit. Large sums have been expended in carrying water from streams in the neighboring Sierra Nevada mountains for a distance of some thirty miles, to be utilized at the mines and mills on the Comstock. But this supply of water is limited and fickle, and by no means meets the demand. Operations have frequently been suspended on [illegible] ship to the [illegible] vast powers not within reasonable range are still [illegible] alone can conserve.



ELECTRIC POWER TRANSMISSION AT VIRGINIA CITY, NEV.—THE PELTON WHEEL.

At the stamp mill of the Nevada Mill & Mining company, water power was obtained at [illegible] of the mill from a reservoir on the side of [illegible] with their complement of pans, settlers, agitat[illegible] rock breakers, etc. The water [illegible] available was entirely inadequate for the operation of the mill.

The problem was submitted to the Brush Electric company, through its agents, the California Electric Light company of San Francisco. A solution was speedily offered, and the plans were accepted by the owners of the Nevada mill and Chollar mine. The shaft of the latter is close to the stamp mill. It was proposed to collect the waste water from the surface wheel at the mill, convey it in pipes to the shaft of the Chollar mine, and thence down the shaft until a sufficient head should be obtained to produce the power required. The scheme was novel, and presented many difficulties. However, experts pronounced the plan feasible, and work was begun last winter.

At the 1,650-foot level of the Chollar mine a subterranean chamber was excavated out of solid porphyry, for the reception of the dynamo-electric generators and water wheels. This chamber is fifty feet in length by twenty-five in width and twelve feet in height, clear of all timbers. From the tank containing the waste surface water, two wrought iron pipes are led to the subterranean chamber, one ten and one eight inches in diameter. At the bottom of the shaft a "Y" unites these two pipes into a single one fourteen inches in diameter, out of which six 6-inch pipes run to the nozzles of the water wheels provided to drive the large Brush dynamo-electric generators.

The underground electrical station is of the most interesting character, and is shown in the illustrations. The large Brush primary generat

ors, of which there are six, are adapted to the conditions by a few mechanical changes from the standard pattern. They are mounted on a heavy cast iron base, and are provided with an extended shaft and outer bearing. On the armature shaft and between two bearings, the Pelton wheel is mounted and inclosed in a water-tight cover. The water wheel is attached to the armature shaft at the place occupied by this pulley, and a coupling is provided for detaching this entire end of the shaft carrying the wheel, from the outer end carrying the armature.

The Brush generators are each of 130-horse power capacity, and are compound wound for constant current. The electrical curve from these machines is almost ideally perfect, and they require no regulator whatever. The current remains of constant strength under all conditions of load.

The head of water at the underground chamber is 1,680 feet. It has never before been attempted to run a water wheel under such enormous pressure. This was, indeed, one of the most serious problems involved in the remarkable installation. The Pelton which was selected is the outgrowth of the old hurdy-gurdy form, and as will be seen from the illustration, its buckets are provided with a very ingenious wedge-shaped partition, by which the stream of water is divided and sweeps out through the [illegible] in such a way as to produce a re-[illegible] effect in addition to the impact. By the peculiar construction of the buckets all the water [illegible] and out of the way of the wheel. The six Pelton wheels are each forty [illegible] diameter, are made of phosphor bronze and weigh [illegible] pounds. They drive the generators at [illegible] of 900 revolutions per minute. The compact arrangement of com-[illegible] water wheel makes [illegible] to the underground chamber to realize the enormous amount of power [illegible] [illegible]

generated. The chamber is brilliantly lighted by thirty-six Swan incandescent lamps operated in multiple series from one of the Brush generators, and there are several of the same lamps in the incline. Each generator circuit is provided with a dead-beat ammeter of the Brush pattern, and a Brush voltmeter is also at hand which is capable of measuring up to 3,000 volts. The generator circuits are led to a switch-board in the same dynamo room, where any generator can be thrown on any one of the outgoing circuits.

In the Chollar shaft are the circuits of copper wire, one to each generator. At one point these circuit wires pass through a shower bath of spray, but the insulation is so perfect that no leakage has yet developed. The wires issue from the mine shaft and are carried above ground to the electric motor room at the Nevada mill. The total length of each circuit is a little more than a mile. In the electric motor room are six motors of the regular Brush constant current type, each of 80-horse power capacity. They are arranged in a single row parallel with the main driven shaft, to which they are all belted in the ordinary manner. The surface water wheel is also connected to this same shaft. It will be noted that there is here a very novel and interesting feature. This surface wheel uses the water in the first instance, and furnishes part of the power to drive the main shaft. The waste water, after this primary use, is carried down the Chollar shaft to the underground chamber, where it drives the dynamos which generate the electric current and energize the electric motors above ground, which in turn furnish additional power to the main shaft.

Each electric motor has its own independent circuit fed from one of the generators. The well-known Brush centrifugal governor, with which each motor is fitted, regulates the speed sensitively, and all or any number of the motors work perfectly in a battery together or with the water wheel. In the motor room there is also an ammeter for each motor. The motors run at a speed of [illegible] revolutions per minute. Some difficulty was anticipated in operating the motors together on one shaft in the manner described, but none was encountered. The motors have not given a moment's trouble or annoyance of any kind from the start.

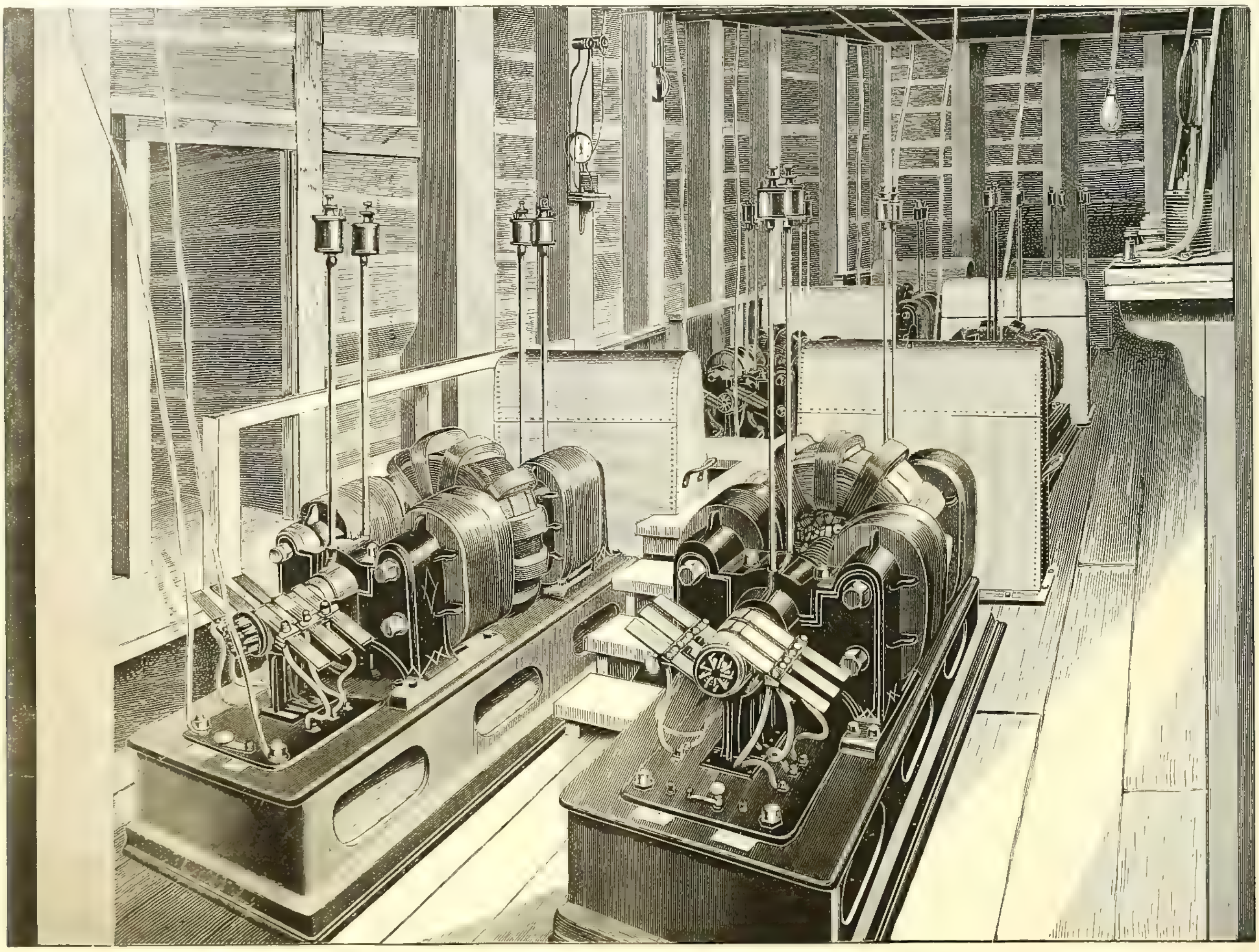
Some idea of the economic value of this electric power plant to the mine owners may be got from a statement of the saving effected by it. The surface wheel alone requires 312 miner's inches of water to develop power sufficient to drive forty of the sixty stamps with which the mill is equipped. Moreover, this amount of water is seldom available. Two of the electric motors, working in addition to the surface wheel, will perform the same service with but seventy-two miner's inches of water, thus effecting a saving of about seventy-seven per cent.

The net commercial effciency of the plant, taking into account all elements of loss, including that in the conducting wires, is about seventy per cent. In other words, seventy per cent. of the power applied to the shafts of the generators in the underground chamber is delivered for work at the main line shaft in the mill.

The waste water from the 1,650-foot level of the Chollar mine is piped into the Sutro tunnel. It is now proposed to use this water a third time at a lower level for other work, by means of a similar application of electrical machinery.

It was expected at the outset that many difficulties would be met in an installation of such novel and original character. The projectors, who assumed charge of the details of the installation, were very greatly pleased to find that their forethought had eliminated the troubles anticipated and predicted in almost all respects. Two purely technical difficulties were encountered when the plant was started experimentally, which caused some delay and anxiety. They were, first, the lack of any governing appliance for the water wheels, and second, the damage to the primary generators caused by the extreme heat and dampness in the underground station.

The Brush Electric company, in its original plans and specifications, stipulated that the



ELECTRIC POWER TRANSMISSION AT VIRGINIA CITY, NEV.—UNDERGROUND POWER STATION.

water wheels should be governed within reasonable limits, but this requirement was not met, and the first generators and motors, started up experimentally, showed the necessity of this provision. The Brush company was surprised to receive by the telegraph the first intimation that the makers of the water wheels had wholly neglected such an important matter, but was fortunately able to close the breach at once. A water wheel governor, invented and sketched out by W. B. Devereux, the mining engineer, of Aspen, Col., had been placed in the hands of the company some time previously, and working drawings of it had been made at Cleveland. These were at once sent to California, the governors were quickly made, and this source of trouble was overcome. F. E. Smith, the electrical engineer in charge of the installation, made several modifications of the governor, after watching its performance, which proved of much value, and it has worked perfectly in practical service.

The second difficulty was met with equal promptness, and likewise entirely overcome. The temperature of the subterranean power chamber is about seventy-two degrees Fahrenheit. The atmosphere is almost saturated with moisture—seventy-eight per cent. Any piece of metal taken into it begins immediately to "sweat." The generators, when placed in this chamber, were soon covered and saturated with moisture, and began to show leaks, while the motors above ground were absolutely free from any trouble.

The Brush company were at once notified of this unexpected source of difficulty, and Mr. Brush speedily devised a method of insulation which would certainly and completely resist the moisture of the sublimated atmosphere. Since its application the generators have worked admirably, and the entire plant is now at work regularly, performing its expected duty and economizing the power available.

The achievement of the Brush Electric company in connection with this plant on the Comstock is a very notable one, and of the greatest interest to mining engineers. The plant is by far the largest electrical power plant in the world.

Producing, Transmitting and Applying Electricity for Street Railway Purposes.[1]

BY FRED. H. WHIPPLE.

In making any comparison of the costs of electric, cable or horse railroads, there are so many points to consider that at least a whole book of this size should be devoted to it to cover the field. The salient points of each system can only be touched upon here. To maintain as near as possible a straightforward description, the subject may be divided as follows:

First: Plant. This includes all lands and buildings, their location, size and cost.

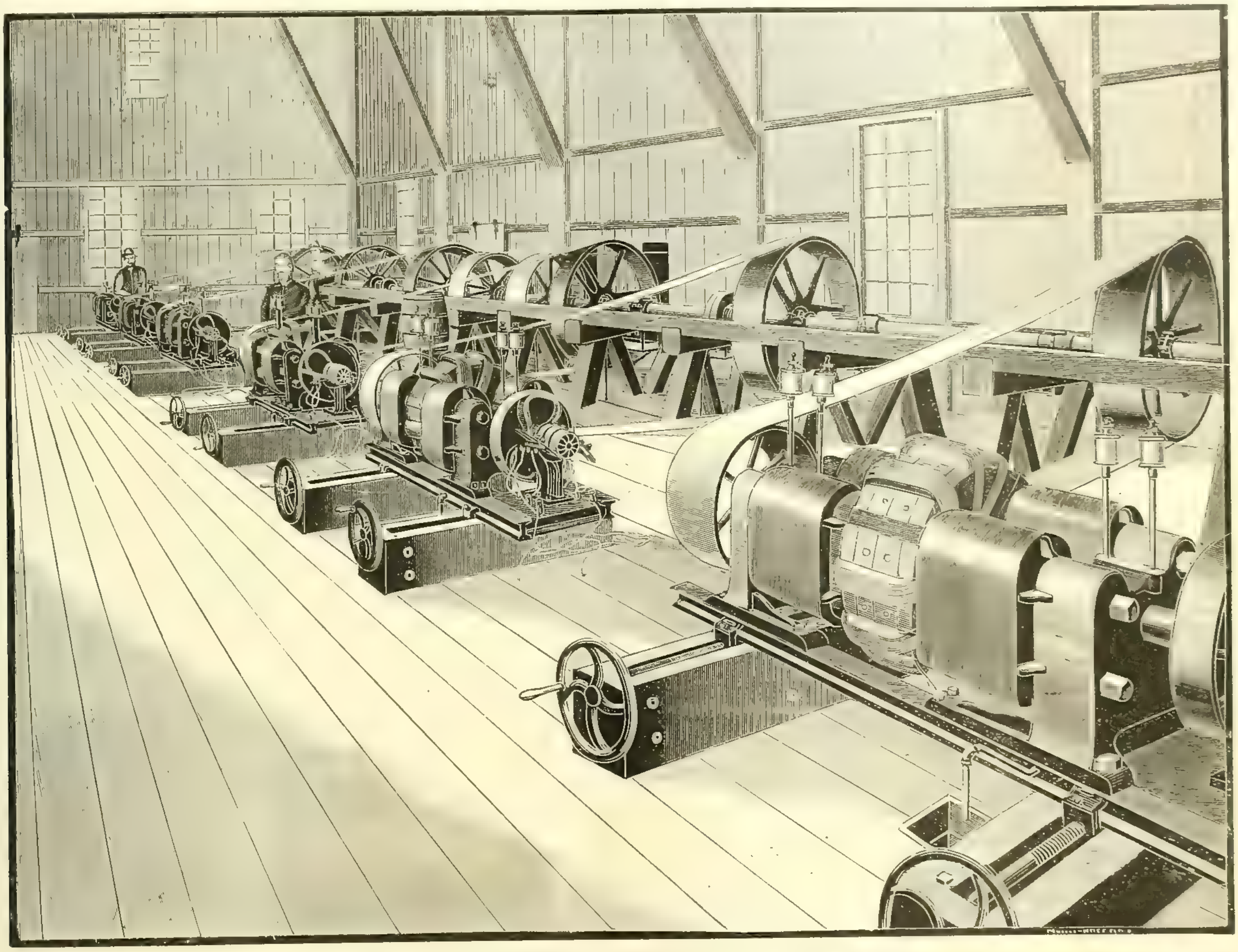
Second: Power. This includes the steam plant; the electric or cable machinery; the horses, storage batteries and motors.

Third: Permanent way, covering track, conduit or overhead work.

Fourth: Rolling stock.

Under the first head—the plant—the two greatest factors are its location and its size. The system necessitating a spread eagle policy on the land question will cost. What could be a more perfect illustration than the horse railroad system? The motive power of the New York Central railroad between New York and Albany could be comfortably stowed in the barns of some of the New York City street railways. What a contrast! The real estate, buildings and fixtures of the Third Avenue line are valued at $1,524,000, and what buildings! Cattle sheds in the metropolis of America. Surely they did not cost a tithe of this great sum. Far from it; but something must have, and that something is plainly the land. Thus it is in every large city of the Union, the expenditure for land being one, if not the greatest, of enormous sums necessary for the company to undergo. State reports usually sum up in this fashion: Permanent way, equipment, land and buildings; and it is to be observed that the third item holds its own, and in many cases exceeds the other two. From the Massachusetts Railroad Commission's report for 1888, it is found that of the total assets and property of all the forty-four street roads in the state, nearly 25 per cent. is in lands and buildings. From the *Street Railway Journal* it is learned that the Central Park, North and East River Railroad company has built a new building, which is one of the largest in the city of New York, being 200 feet front by 475 feet deep, and four stories high—95,000 square feet of land, costing at least $1,000,000. This for about 1,300 horses, or allowing ten horses to a car, a working force of [illegible]

[illegible] feet as the total area necessary for the whole plant; as against [illegible] square feet necessary for horse plants, [illegible] This shows [illegible] assuming [illegible] plants were the same.



ELECTRIC POWER TRANSMISSION AT VIRGINIA CITY, NEV.—MOTOR ROOM.

Let us look a little further into this matter of ratio between space for steam plant and that for horses. From careful examination of many engine plants, considering the ratio between a certain number of horses with their necessary adjuncts, and a steam plant of numerically equal power, I find it stands as one to thirty. That is, a steam plant complete of 30 horse power capacity would need only the floor space of one horse. With larger powers this ratio is still greater, and from one estimate it stood as 1 to [illegible] [illegible], for horses one would have to have [illegible] times more floor space than for an equal number of mechanical horse power. It was from one maker, taking the engine alone, I found that a rated 100 horse power engine, guaranteed in every particular, would have ample room in the stall for one horse in the average stable. Another instance showed that one could get a steam plant complete, engine, boiler, etc., of 50 horse power in a space five by six feet, which is much smaller than the average stall.

From scores of electric plants and many cable plants it is found that it is safe to allow twelve square feet of floor for every horse power of energy going into the street. This figure will cover boilers, engines, dynamos or gears, pumps, heaters, condensers and a generous coal bin. With very large plants it is true that a still less figure will answer for the steam plant. With horses at least [illegible] square feet are necessary.

In regard to the storage and handling of cars in general terms the floor space would be about [illegible] in these cases. It is, however, to be noted that since the [illegible] time of the cars can be decreased, a less number is neces-

[1] Chapter from Mr. Whipple's forthcoming book on Electric Railways.

sary with power than with horses, hence a saving is sure to follow, due to this cause. It may be argued that the cost of a suitable building for a steam plant would far exceed that of one for horses. This is no doubt true to a certain extent, but I do not think that its increased cost could ever balance the saving in real estate.

With electricity alone, then, exists another advantage which has not yet been mentioned. Since hoisting power is at hand, and the cars can be as readily handled from an overhead wire in a building as in the street, the driver of each car can run it upon an elevator, and upon being hoisted to any floor can store it wherever it is desired.

Thus far it has been assumed that the steam plant and the car house be one and the same building. If, however, we separate the two the question of cost for land for the electric system becomes a very simple problem. With neither cable nor horses is this true. While it is advantageous to locate the electric plant for the direct system as near the center of the track system as possible, it is not imperative, but in the suburbs or off on cheap land the station can be built and

ning arresters, switches, etc., would cost for the electric plant, about $50 per horse power, or $65,000. The cost of the gears, foundations, tension buggy, etc., for the cable plant would be about $40 per horse power, or $52,000. A total for the electric plant of $136,500, and for the cable of $123,500. For horses, I would estimate the 1 300 horses at $150 each, making $195,000. Allowing $12,000 for harness and appurtenances, there would be a total of $207,000.

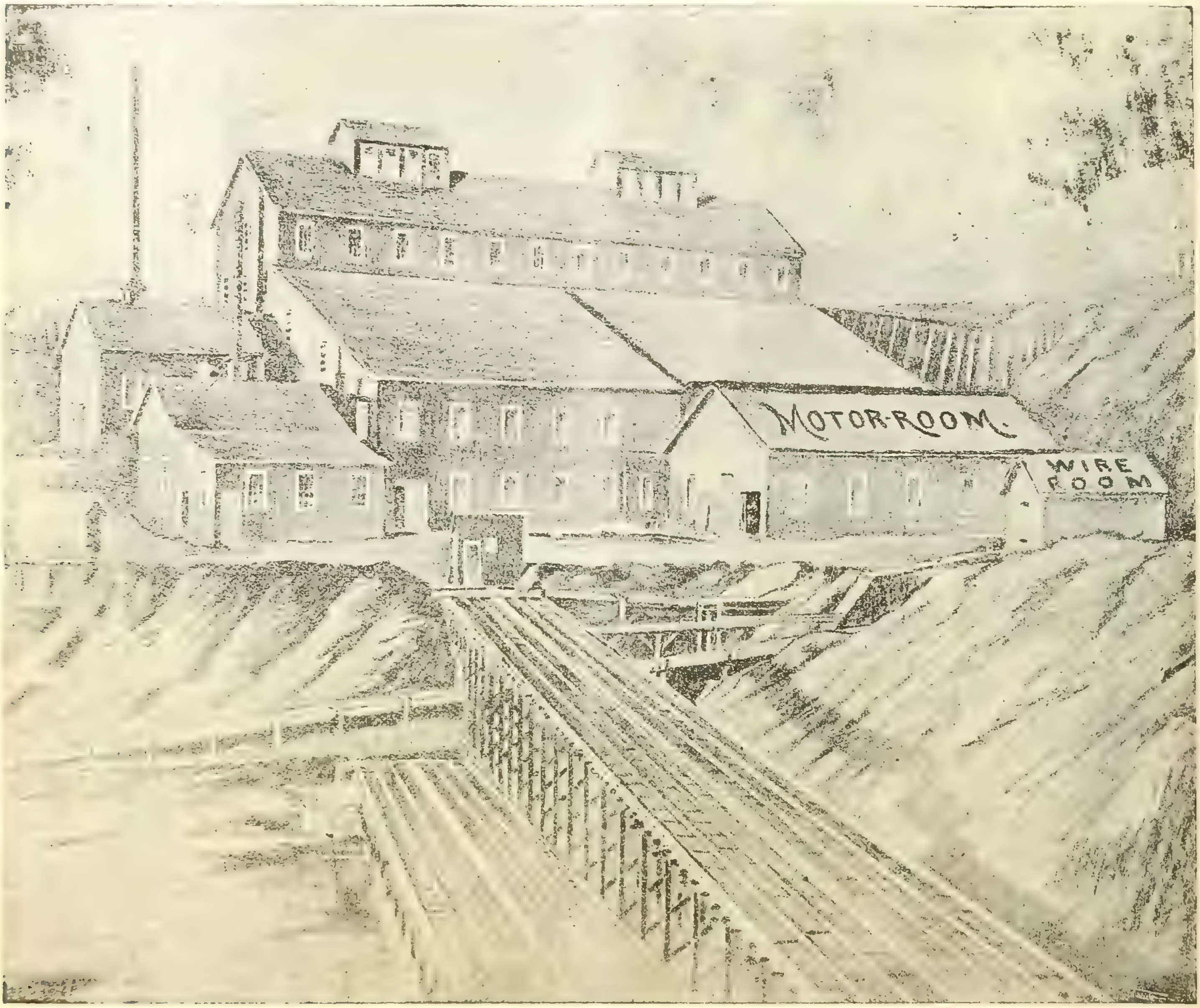
If the road was operated with storage batteries, an approximate cost could be arrived at as follows: If the cars are run sixteen to eighteen hours out of the twenty-four, it is certain that practically as large a steam plant is necessary to charge the batteries as is necessary to operate the road by the direct system, for, if there were 130 cars out, there must be in the car house 130 sets of batteries being charged to take the place of the exhausted ones soon to come in. In practice, it has been stated that one charge will last from five to twelve hours, and propel a car thirty to 100 miles, according to the battery used. As the regular service of an electric car is about 100 miles a day, at least

side of the cars, and are so arranged that the batteries can be charged while on them, and then readily rolled into a car, whenever necessary.

A fair approximation for land and building would be, for the direct system, $40,000; storage, $45,000; cable, $40,000; and horses, $35 000.

In estimating for the permanent way, the track, evidently, should be the same in all cases, and it has been accordingly estimated at $7,000 per mile of single track The electric conduit is estimated at $30,000 per mile of single track; and the cable at $65,000 per mile of single track. The overhead electric system is estimated at $3,000 per mile, since it is taken for granted that for a road of such magnitude it must be in a city where iron poles would be required.

For rolling stock, the car bodies are estimated at $700 apiece. The electric trucks are estimated at $3,000 apiece, and of fifteen horse power. They include wheels, axles, pedestals, two motors and all controlling devices The grips for the cable cars are figured at $150 each. For the



ELECTRIC POWER TRANSMISSION AT VIRGINIA CITY, NEV.—EXTENSIVE STAMP MILLS ELECTRICALLY OPERATED.

[illegible] costing but a few hun[illegible] [illegible] to the track.

[illegible] to locate a power [illegible] possible. By this is meant, [illegible] be brought to the city in [illegible] them.

[illegible] desirable to [illegible] supply of water, as [illegible] system, [illegible] In regard to coal, if it [illegible]

three charges will be necessary in some batteries. It ordinarily takes as long to charge, if not longer, than it is allowable to discharge. On small roads, a saving can be effected through the fact that, the cars not running more than twelve or fourteen hours out of the twenty-four, the engine plant can be reduced but run longer. For a road which has been under discussion, I would allow as the cost of the steam and electric plant, $135 500. This is an amount equal to that allowed for the direct system

In regard to land area allowances can be made as follows: Electric direct system, 15,000 square feet, electric, storage system, 18,000 square feet; cable, 15,000 square feet [illegible] square feet In valuation, I have estimated the land at thirty cents per foot, and I then have for electric direct system, $4 500, storage system, $[illegible], cable, $[illegible] and for horses, $[illegible]. For buildings, I have allowed for the direct system, $20,000, storage, $[illegible], [illegible] $[illegible], and horses, $[illegible].

I have not yet considered the car house. It is plain that for all systems [illegible] approximately the same, [illegible] point to be considered. [illegible] and cable systems would be [illegible] and in the case of the storage [illegible] to properly handle the [illegible] has devised an ingenious [illegible] upon which the batteries [illegible] and located on either

horse road the cars are placed at $900.

To obtain from all the foregoing an approximate total cost, the figures have been arranged in tabular form. There may be slight discrepancies, but, as near as I have been able to gather, I would judge that the figures fairly represent the ratios of cost as they exist to-day for fifteen miles of track and 130 cars. [See table on following page.]

In discussing the operating expenses of a road of such magnitude, first approximately estimate the cost of producing one horse power. In any case ninety per cent. of the engine energy would be delivered to the wires leading to the motors on cars, to storage batteries, or from the gears to the cable leading to the street. The estimated expenses per annum would be about as follows

Coal [illegible] pounds per horse power [illegible] $3, or [illegible] [illegible]	$[illegible]
Superintendent and manager	[illegible]
Assistant superintendent and electrician	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Oil [illegible]	[illegible]
[illegible] and [illegible]	[illegible]
[illegible]	[illegible]
Water	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	$[illegible]

COST OF CONSTRUCTING STREET RAILWAYS.

	Electric Overhead.	Electric Conduit.	Electric Storage.	Cable.	Horses.
Land	$ [illegible]	$ 4,800	$ [illegible]	$ [illegible]	$25,800
Buildings and foundations	[illegible]	[illegible]	[illegible]	25,000	15,000
Engines, boilers, dynamos and gears	138,300	139,300	156,300	124,500	
Car bodies and trucks	[illegible]	10,000	150,000	40,000	
Horses and harness					75,000
Storage batteries			157,500		
Car-body motors or gears	[illegible]	4[illegible]	[illegible]	1[illegible]	
Conduit		[illegible]		[illegible]	117,000
Cable				19,500	
Overhead system	45,000				
Track	[illegible]	105,000	105,000	105,000	105,000
Totals	$[illegible]	$[illegible]	$1,[illegible]	$1,[illegible]	$307,[illegible]

allowing eight horse power per car the cost per [illegible] be $1.95.

In the case of horses I have allowed te[illegible] for [illegible] twenty five cents per day for feed, making per [illegible] cost of $2.[illegible]

There are now left the further items of repairs, interest, depreciation and supplies to add to the cost of power to complete the total operating expenses per car. These have been arranged for the various roads in tabular form:

	Electric Overhead.	Electric Conduit.	[illegible]	[illegible]	[illegible]
Power	$1.47	$1.47	$[illegible]	[illegible]	$[illegible]
Repairs, [illegible]	1.85	[illegible]	[illegible]	1.35	.50
Depreciation, power and rolling stock	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Interest, power and rolling stock	.77	.77	[illegible]	[illegible]	[illegible]
Attendance	.45	.45	[illegible]	[illegible]	[illegible]
Supplies	.25	[illegible]	[illegible]	[illegible]	[illegible]
	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]
Permanent way, De[illegible]	.25	[illegible]	.17	[illegible]	[illegible]
" " In[illegible]	.17	[illegible]	[illegible]	[illegible]	[illegible]
	.42	[illegible]	.30	[illegible]	[illegible]
Total	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]

In this table no office salaries or labor account of drivers and conductors has appeared. There being so little difference, to avoid complication it was omitted. In estimating depreciation, I am aware that some figures have had to be taken for which I had no actual reliable data. There are other considerations of which I have taken no account, which would modify one or two of the figures to a slight

DAFT ELECTRIC RAILWAY AT CINCINNATI.

Per horse power for one year this is $53 as the total cost, or per horse power hour about one cent. Take this figure as a fair average for all cases.

According to this, if we lose 10 per cent. of this amount as energy in the overhead conductors, or in the conductors in the electric conduit, and another 10 per cent. in the motors, and 5 per cent. in the gears, we would have as the cost per horse power per year delivered at the wheels of the electric car, $67 33 If the car takes on the average eight-horse power, we have as the cost for power per day, $1.47.

In the case of the conduit system the cost of power would be the same.

With the storage system a slight increase of cost is inevitable. Starting with the original cost at $53, there would be a loss of 20 per cent. in the batteries, 10 per cent. in the motors, and 5 per cent. in the gearings. This places the cost per horse power per annum for power delivered to the car wheels at $73.41. Since the weight of the batteries must be carried, and they form about 50 per cent of the total weight of the car, so much more power will be required, and I have allowed nine horse power per car. At this rate the cost of power per car per day is $1.80.

In the case of the cable road the best engineers place the loss at 70 per cent. At this rate the cost per horse power delivered at the wheel per annum would be $89.10, or extent. It is true, also, that I could have allowed all the way through a less number of cars for the system operated by mechanical power, since a higher rate of speed could be maintained. I, however, carried the estimate through with an equal number to make as fair a showing for horses as possible. The table must stand for just what it is intended, and, as in every estimate of this kind, is open to amendment; but the ratios will stand the test of actual practice.

Again, it must not be thought that the same ratios would hold true with the receipts. People infinitely and universally prefer mechanical power as their propelling agent. It is therefore reasonable to believe that those which are shown to be more expensive than horses could very successfully compete with them. The limitations of a horse road are self-evident. It has so many inherent faults that it is needless to discuss them. As, however, it has often been advanced that electricity would never compete with the cable system, a few of the comparative points between the two systems might be advantageously glanced at.

A dispatch from Peoria, Ill., May 16th, says: The long fight in the city council over the question of substituting electricity for horses and mules on the street railways in this city was settled to-night by the passage of the electric ordinance.

Daft Electric Railway at Cincinnati

[illegible]

[illegible] upon, while their adaptability to all conditions of the overhead line secures a permanent and reliable service.

The cars are equipped with [illegible] power to enable them [illegible] cars, if necessary. They have frequently, in addition to their own load, pushed the Avondale cars up a 7½ per cent. grade when the [illegible] were wet from street sprinkling. For a short distance electric cars run over the cable line tracks, and one of them recently pushed a heavy cable train of two cars, which had been derailed, back on the track.

The road has now more than 600 feet of straightaway track. There are in a single mile six cross-overs, eight curves, grades as high as 7½ per cent., continually wet from sprinkling carts, and this in a narrow, crowded thoroughfare. Under these conditions the commercial service of the Daft motor cars demonstrates that the system in Cincinnati has scored a success, and justified the confidence reposed in it by the street railway company. The construction and equipment of this line have been of the best character, and the service is highly commended.

Although the line has just passed through the test of a first trial, in which delays and breakdowns are naturally expected, none has occurred, and the operation of the electrical and mechanical features of the road has given satisfaction, not only to the general public, but to the management as well.

The Improved Phonograph.

Since the phonograph company begun manufacturing the improved machine recently completed by Mr. Edison, it has been taxing the capacity of its factories, and now it is turning out fifty machines a day. The new instrument is represented as far superior to the old one, showing a marked improvement in the reproduction of tones, the sound being louder and much more distinct than in the old machine. The Illinois & Indiana Phonograph company of Chicago hopes to begin booming the instrument in a few weeks.

Reduction in Copper Wire.

It is stated on good authority that the combination controlling the price of copper wire has ordered a reduction of 4½ cents per pound. This is understood to be due to the general decline in price of copper.

New York Electric Club.

The secretary of the New York Electric [illegible] circular to the members, writes: "The increased [illegible] the club resulting from the change in the [illegible] permit several desired improvements to be [illegible] house. The course of lectures which was so successful in the past will be continued. The members may expect this feature of the club to be particularly [illegible] during the present year. The club [illegible] growing in influence and membership and [illegible] year of existence with [illegible] strength [illegible] popularity that assures its success in the future. [illegible] well established and may now be classed [illegible] substantial institutions of the country [illegible] sive electrical fraternity. Members [illegible] Paris Exposition will find the [illegible] May 20, 1889. A [illegible] be held until [illegible], and all visitors are requested to register their names and their [illegible]

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W. A. KREIDLER, Editor and Publisher
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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome; and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

ADVERTISING.—THE WESTERN ELECTRICIAN—*the only electrical weekly published in the West*—thoroughly covers a territory *exclusively its own*. THIS IS A CLAIM WHICH CAN BE MADE BY NO OTHER ELECTRICAL JOURNAL IN THE UNITED STATES. Electrical merchants and manufacturers *desiring Western trade* will appreciate the UNEQUALED VALUE of this journal as an advertising medium in its special field. Advertising rates are moderate and will be promptly furnished on application.

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THE wonderful activity in the electrical field is again illustrated by the fact that forty-three patents relating to electrical inventions were issued last week. During the first three weeks of the present month 113 electrical patents have been issued.

AN illustration of a new alternate current motor appears in this issue, and as so much has been written about the machine the description detailing the work which it is performing will be read with interest. It is worth noticing that in all the installations referred to in the article water power is utilized to operate the primary generators.

IN this week's New York letter attention is called to the experiments recently made in the proposed electrical mail service. The test which was made at Boston proved satisfactory, and those who were present are confident that it will prove successful when applied on an extensive scale. Practical difficulties may arise to prevent its general adoption immediately, but all who [illegible] are confident of the ultimate success of the proposed system.

A[illegible] the city electric light plant of Chicago will be extended considerably [illegible] completed [illegible] will be commenced [illegible] of operation is explained in detail elsewhere. It will not, of course, [illegible] entire city with electric lights immediately, it will require time [illegible] the better they like it. The city plant is a success; it is the most popular institution in the city of Chicago, and the people are anxious to have it completed. It has more than met their expectations, and their desire to increase it is ample proof of the wisdom displayed in introducing electric lights for street illumination.

SPECIAL courses in electrical engineering are being made prominent features of American educational institutions. President Patton of Princeton has announced that the new course in electrical engineering which is to be instituted at the beginning of the next collegiate year, will extend over two years. Students who have passed through the junior year in the academic course, including the elective work in mathematics, and the students who have completed the junior year in the John C. Green School of Science, will be admitted to the course. Others will be admitted on passing a satisfactory examination.

AN illustrated article descriptive of the celebrated power transmission plant on the Comstock lode in Nevada appears in this issue. The problem which has been solved by the successful operation of the plant was one of the greatest magnitude, involving difficulties at every step, both mechanical and electrical, yet each one has been overcome. The installation illustrates in a striking manner the advantages attending the electric distribution of power. The plant has already attracted considerable attention in Europe, as well as the United States, though a full description of the installation has never appeared before.

WILLIAM KEMMLER of Buffalo may claim the distinction of being the first person ever sentenced to be executed by the application of electricity. The sentence was pronounced by Judge Childs in these words: "The sentence of the court is that for the crime of murder in the first degree, whereof you stand convicted, within the week commencing on Monday, the 24th day of June, 1889, and within the walls of Auburn State prison, or within the yard or inclosure adjoining thereto, you suffer the punishment of death, to be inflicted by the application of electricity as provided by the Code of Criminal Procedure of the State of New York, and that in the meantime you be removed to and, until the infliction of such punishment, be kept in solitary confinement in said Auburn State prison." The prisoner's counsel, as was expected, took an exception on the ground that the sentence was cruel and unusual, and against the spirit of the constitution. The exception is based on this provision of the constitution: "Excessive bail shall not be required, nor excessive fines imposed, nor cruel or unusual punishments be inflicted." It would be hard to prove that the new method of inflicting the death penalty was cruel, inasmuch as it was recommended as more humane than hanging by a commission appointed to consider the question. True it is that execution by an application of electricity is unusual in one sense, but it seems to be equally certain that in the same way every new penalty is unusual in so far as it has not been in practice before.

The death warrant in the case is directed to the warden of Auburn prison, and provides that the sentence be executed "upon some day within the week commencing Monday, the 24th day of June, in the year of our Lord 1889, and within the walls of Auburn state prison, or within the yard or inclosure adjoining thereto, by then and there causing to pass through the body of him, the said William Kemmler, a current of electricity of sufficient intensity to cause death, and that the application of such current of electricity be continued until said William Kemmler be dead."

There is some fault found with the somewhat elaborate plans for electric executions. The *Nation* puts the complaint into interrogatory form, as follows: "Is it certain that the framers of the law intended that the victim should be seated in a formidable-looking chair, have his feet encased in shoes which contain damp sponges, have another sponge placed on his head, and his head clamped down with metallic bands, all this to be gone through with as a preparation for the death stroke? Was it not believed when the law was passed that the victim would die with the touch of a wire or knob, and was not the absence of terror-giving paraphernalia and preparations one of the arguments in favor of the new means of death?"

THE effort to cause electric companies in Detroit to bury their wires has developed a curious state of things. A general ordinance requiring all wires to be buried, is in force. At its passage six months was given to bury the wires within half a mile and one year to bury all within a mile of the city hall. These time allowances have expired. The police department complied with the half-mile provision. It purchased a lot of poles and wire and was hanging its patrol wires between the half-mile and mile circles when ordered to stop by resolution of the common council. The city counselor began suits against several companies, charging them with maintaining public nuisances in the form of overhead wires. He, however, did not have the heart to push the cases when the city itself persistently violated the ordinance. The police commissioners state that they have no money for defraying the expense of putting their wires underground, so they are of necessity inactive. It has been determined to put the city right in the matter before adopting extreme measures with the companies. In reading of the progress of the agitation in Detroit, one is struck with the fact that there seems to be a desire on the part of both the authorities and the companies to settle the matter harmoniously. One of the companies, for example, proposes to lay one of its electric light circuits underground, in the best conduit obtainable. This is to be done under the inspection of an expert to be employed by the city, if the council so elects. If a year's trial proves the conduit a success, the work will be extended until all the wires are underground. It is likely that the proposition will be accepted. If municipal authorities and representatives of companies would work for a compromise such as that proposed in Detroit, a good deal of the clashing which now is so frequent might be avoided.

ELECTRICAL matters are receiving considerable attention in Japan. Only a short time ago attention was called to this fact by the publication in this paper of an interview with Lieutenant Kozo Yoshi of the Japanese navy who visited Chicago in March. He had been commissioned by the Mikado to study the application of electricity in the United States navy. Additional evidence is furnished by the visit of Shigenori Katogi, who is commissioned to make a special study of practical telephony. Mr. Katogi has just arrived in this country. He called at the office of the WESTERN ELECTRICIAN last week, and presented the following letter from Prof. R. Shida, director of the Department of Engineering, Ministry of Communication, Tokio, Japan: "The bearer, Mr. Shigenori Katogi of Tokio, Japan, was for thirteen years connected with the Imperial telegraph department, and latterly with the electrical laboratory of the Department of Communications. He leaves Japan in order to prosecute his studies in telephony and electrical work generally." Mr. Katogi said that experiments are now being conducted in Japan by the government with a view of establishing an electrical railway. Thus far the experiments have been successful, and it is thought that an extensive system will soon be introduced. Electric lighting is now in general use, and the telephone is gaining popular approval. The great obstacle is the lack of central stations. The switch board is unknown in Japan, and Mr. Katogi will make this feature a special study. The government has recently begun the manufacture of copper wire on an extensive scale. According to Mr. Katogi, many of the brightest men in the Mikado's domain are giving the study of electricity their special attention, and they are making rapid progress. Another recent departure in Japan was the operation of machinery by electric power. Since the introduction of motors in the empire, they are being used for every conceivable purpose. The Japanese are enthusiastic on the subject, and are eager to avail themselves of all the latest developments in electrical science.

The Topeka Rapid Transit Railway.

The electric railway at Topeka is the longest line which has yet been built using one system, and receiving its current from one central station. The roads which have heretofore been built by the Thomson-Houston company in the west have been constructed in the best possible manner, and are successful in every particular; but the road in question is by far the longest, and no pains have been spared to make it a model road in every respect. The construction work was begun about January 1st, and finished about the 1st of April. When it is called to mind that this road is fourteen miles in length and has a total length of track of twenty miles, and that the utmost care was exercised in its construction, even to the smallest details, it will be seen that good time was made.

The trial trip was announced for April 3d, and was most successful in every way. The directors of the road and about 100 invited guests made the trip, and at its close expressed themselves in the highest possible terms of the action of the motor cars, the ease with which they could be operated, and the vast improvement which they were over horses and steam motors. It was quite a gala day for Topeka, the public generally turning out to witness what was to them a novel sight. It seemed to be the general opinion that rapid transit, which the electric railway would afford, was to be of the utmost benefit to the city. The power station, a very handsome brick building, is illustrated in the accompanying cuts. It is located at the corner of Jefferson and Second streets. It has a front of 100 feet and a depth of eighty-five feet. One-half of the building is two stories in height. At the rear of it is a massive brick chimney 125 feet high.

The foundations of the dynamos and engines are of solid masonry resting on bed rock, thus securing the utmost stability and firmness. The engines are two in number, and are of the Corliss type. They were built by E. P. Corliss & Co. of Milwaukee, subject to a special order by L. H. McIntire, the mechanical engineer who has designed and superintended the construction of the entire plant. The smaller engine is capable of developing 300-horse power, and has a fly-wheel twenty feet in diameter, weighing 26,000 pounds. The larger engine is of 600-horse power, and has a 20-foot fly-wheel weighing twenty tons. The smaller engine, as will be seen on reference to Fig. 2, is situated at one end of the building, the larger one directly opposite, and both are belted to the main shaft, which runs the entire length of the [illegible]. Each engine rests on a foundation [illegible] a concrete base, upon which are [illegible] blocks of stone laid in cement to a thickne[ss of] about ten feet. The foundations are enti[rely] independent, so that when the engines a[re run]ning there is no appreciable jar [illegible] to the building. The engines are [illegible] revolutions per minute.

The battery of five boilers, which supplies the steam for these engines, is located between them in a brick inclosure, which entirely isolates it from the dynamo and engine rooms. [illegible] boilers are built of the best quality of steel, are six feet in diameter, and are each sixteen feet long. They are arranged so they can be [illegible] separately, or in series. The feed water for these boilers is taken from driven wells sixty-five feet deep. The water is first pumped into an exhaust heater, and the temperature is raised to 212 degrees Fahrenheit. A peculiarity in this exhaust heater is, that the water enters at the top, and is received by a crescent-shaped pan. From this pan the water runs over the edges, following the bottom until it reaches the center of the pan, when it drops into a similar shaped pan, and so on into another pan, until it passes into sixteen different pans. By this arrangement the exhaust steam strikes the water as it drops from pan to pan sixteen different times, and removes all the impurities that can be taken out with the above mentioned temperature. This water is then delivered by a special pump, fitted for handling hot water, into a superheater which is placed above the boilers. This heater is twenty-six feet long, and contains twenty-four pans like those used in the exhaust heater. Live steam from the boiler is kept at full pressure upon this superheater, which carries the temperature up to 320 degrees. The high temperature to which the feed water is subjected causes the lime, iron, magnesia and other impurities to collect in the bottom of these pans.

The floor of the boiler room is paved with hard brick. A track for a coal car runs in front of the furnace doors, enabling the firemen to transport coal from without the building to the furnace.

The electrical apparatus consists of five 80-horse power Thomson-Houston generators for supplying the necessary current. These generators are shunt series wound and connected in multiple. There is also a large switch-board fitted with the necessary current indicators, switches, etc. In building the line the overhead method of construction has been employed, the [illegible] [...]er, are [illegible] railway.

TOPEKA RAPID TRANSIT RAILWAY—THOMSON-HOUSTON MOTOR CARS.

Western Telephone Combination.

[illegible] Milwaukee [illegible] . and retir[ed] [illegible] Payne left to-day for Boston, where he will [con]sult with the corporation which w[ishes to secure] his services, and finally decide whether to [ac]cept the [illegible] offers [illegible]. The corporation which desires to get Mr. Payne at the head of one of its latest [illegible] enterprises is the Bell Telephone company, and the position offered is that of president of the western consolidated companies of the Bell company, with headquarters in Chicago. The enterprise marks a departure in telephoning, and will consist of a long-distance system connecting Chicago, St. Louis, Cincinnati, Indianapolis, Omaha, Kansas City, St. Paul, Minneapolis and Milwaukee. The center of this system will be Chicago, and through that station New York, Philadelphia, Boston and Washington will be connected with all the other points. The Bell companies embraced in this great consolidation will be those of Illinois, Iowa, Michigan, Indiana, Minnesota, Ohio and Missouri. Wisconsin alone will not be in the consolidation, as the Bell company does not control it. Henry C. Payne is now the president of the Wisconsin company."

Chicago telephone men know nothing about the proposed combination, and appear to take little stock in the story; in fact, a representative telephone man stated to a representative of the WESTERN ELECTRICIAN that he discredited the story because the western managers had not been consulted, and he doubted very much if such an important step would be taken without a consultation.

Secondary Batteries.[1]

BY WILLIAM HENRY PREECE.

PART I.

Secondary batteries are often called accumulators and storage batteries, and the general impression is that they accumulate or store that which is called "electricity." What is accumulated or stored is, however, energy in its chemical form. A *secondary* battery is really a battery pure and simple, but it differs from a primary battery in this, that the chemical character of the conductors or plates and the electrolyte in which they are immersed has been excited by an electric current which has passed through them continuously for some time, while in a primary battery the chemical affinities exist in the materials of which the cell is composed. In the language of the distinguished American, Judge Coxe, "A secondary battery is one which gives no electricity of itself, but is active only when rendered so by a current from an independent source."

Secondary batteries have become an essential feature of every properly equipped isolated electric light installation, not only for the regulation of electric currents and the maintenance of uniform electromotive force, but to give a store of energy to draw upon at night or when any accident or failure occurs. They are also employed for the distribution of electrical energy from central stations. They are used for ship and for train lighting, and they seem destined to solve the important question of economical [illegible] our tramways. They are much used in telegraphy. [illegible] have passed through a very severe ordeal of seven years practical development in the face of [illegible] and in spite of the prejudice resulting from [illegible] mercial speculations and from the [illegible] sanguine hopes and hasty utterances [illegible].

The father of lead secondary batteries [illegible] is the eminent [illegible] at the time [illegible] that made the apparatus [illegible] discovery of [illegible] the application of oxides of lead [illegible] cement on the surface of the lead [illegible] the process of [illegible] of the plates [illegible] Volkmar [illegible] have [illegible] done so much [illegible]

My [illegible] these batteries since March [illegible] After two years of experiment I selected twenty-six cells of the 15L E. P. S. type, with which form of cells I am now working. Their [illegible] fact On March 30th my gas engine broke down. I quite forgot to give notice to the makers to send down men to repair it until six days had elapsed. It took five more days to repair the

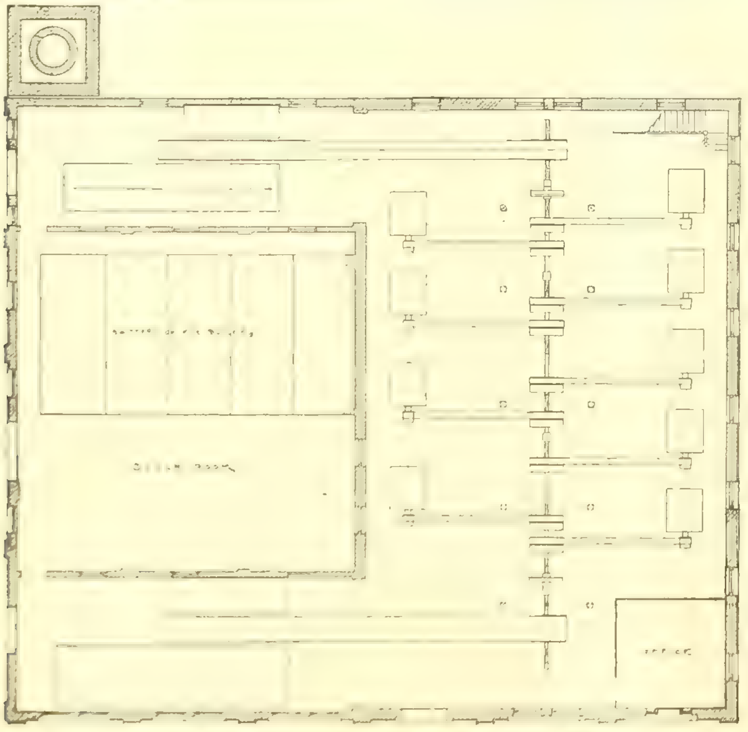
TOPEKA RAPID TRANSIT RAILWAY—MOTOR HOUSE

engine, so that for eleven days I had not been able to recharge the cells; but during all these days the light never failed, and we were not in any way inconvenienced. The useful capacity of my cells is 330 ampere-hours, and my nightly consumption is now about 30 ampere-hours. This was a very good test of the efficiency of the cells, for I obtained from them nearly all the energy they could usefully give. Only two cells were really exhausted during this time, but as I had two spare cells to replace them, their exhaustion did not cause me any inconvenience The e. m. f. fell to 1.8 per cell, and the light in consequence was not so brilliant as usual. A good practical test of the efficiency of a battery like this is better than any isolated tests on single cells.

The illumination of this hall (Society of Arts) is regulated by fifty eight E. P. S. cells, of 13L type, an obsolete form, which are used, when the hall is not open, to light the secretary's and the public offices. They have been at work since January, 1885, and have given no trouble and very great satisfaction.

There are several kinds and types of cells in use at the present day, but the principal ones supplied in England are by the Electrical Power Storage company and by Elwell Parker company. The E P. S. cells are of several patterns.

The plates of each E. P. S. cell are divided into the positive and negative, in each case a pure lead grid being cast for retaining the paste-oxide [illegible] thick and weighing five pounds. The perforations or openings of the positive plate are filled with minium, while those of the negative plates are filled with litharge. The plates so prepared are then subjected to powerful currents for several hours, when the litharge (PbO) is reduced to spongy lead (Pb) and the minium and red lead (Pb_3O_4) become lead peroxide (PbO_2). There is thus economy in reducing the lower oxide and in peroxidizing the higher one Many attempts have been made to manufacture the grids of inoxi-

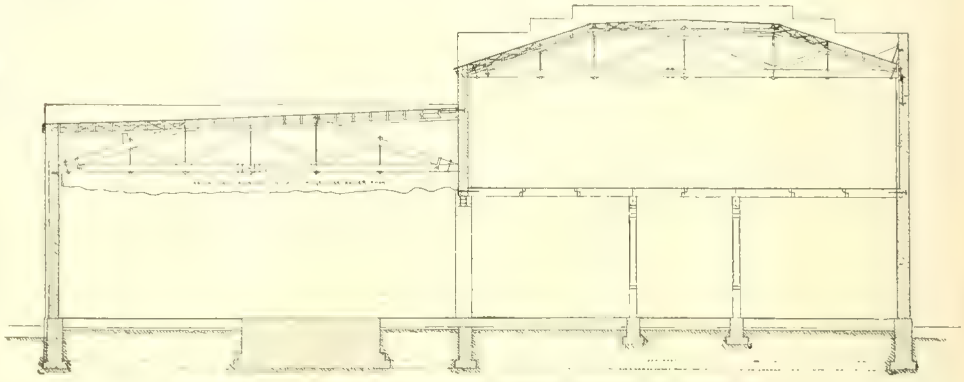


[illegible]

[illegible]

them to do more than they were designed for, neglecting to maintain the level of the liquid and its density—that principally lead to deformation, disintegration, and also short-circuiting from the paste falling out in plugs and resting across the plates. The plates are now fixed three-eighths of an inch apart, a sufficient distance to allow any pellet that may fall out to drop harmlessly to the bottom of the cell. This distance can be increased with advantage.

The pellets of paste are now made considerably smaller than was the case at first, and this has been done to hasten the period of formation, and to render the whole of the pellet active, which was not always the case with the larger pellet, for their centers were often found unformed, and therefore idle.



TOPEKA RAPID TRANSIT RAILWAY—TRANSVERSE SECTION OF MOTOR HOUSE.

The negative plates of each cell rest on toes or blocks, and are maintained 1½ inches clear of the bottom of the cell, and they suspend the positive plates by lead bars running along each side of the negative section, on which ebonite supports carry the positives. All the plates of each kind of each cell are welded or burnt on to a broad lead strip, to which either a terminal is attached or which is burnt on to the strip of the next cell.

[illegible] permanent installations, are of [illegible] purpose they are gener-[illegible] watertight by lead, [illegible] preferable [illegible] for it is very useful [illegible] packing are behaving. [illegible] made of an inoxidizable [illegible] received with favor [illegible] that it is an excellent insulator, though owing to its hydroscopic tendency it has been found necessary in some cases to mount the cells on oil cups—a plan that is always necessary with wood and metal boxes.

The electrical leakage from glass cells when the acid spray is checked is very small, indeed. They retain their charge unimpaired for months It is, however, a good plan to paint the glass over with paraffin or vaseline occasionally. It checks leakage and prevents the acid from creeping.

The form of cell supplied by Elwell-Parker differs in several details from the E. P. S. pattern, though it is of the same type. The plates are held together by side frames of wood or vulcanite at the edges, so as to knit them together very firmly and prevent buckling. The whole frame of the largest size can be lifted in and out by a crane with ease. The negative plates are made in a way which prevents blistering, a defect in the E. P. S. plates, and the grids are burred in a way which prevents the pellets from dropping out. This process, due to Messrs. Drake and Gorham, is an important improvement.

The capacity of a cell is the amount of energy it will accumulate and usefully restore It is measured roughly either in ampere-hours or in watt hours. The latter is the more accurate if the fall of e. m. f is carefully noted, but if the e m. f. is maintained fairly constant by not running the cells too low, the former is equally practical and more common. The average type of cell, such as the stationary E. P. S. pattern, gives a useful capacity of 4 ampere-hours per pound of plates complete. I have had a cell (Fitzgerald's lithanode) which gave a return as high as 5.7 ampere hours per pound, while the Plante type rarely exceed 2 ampere-hours per pound. The portable form used for traction purposes gives 5 ampere-hours per pound, but this is only because the plates are much lighter.

The efficiency of a cell is the ratio between the energy taken out of it to the energy put into it, and the useful efficiency is usually taken from the number of ampere hours discharged when the e. m. f. falls 10 per cent in magnitude. This figure is a very variable quantity, for it depends very much on the current density; that is, upon the number of amperes per unit of surface one square centimeter of plate The following experiment on a small cell illustrates this point:

Current density.	Ampere-hours.
.013	44.6
.048	36.5
.09	30.2

The ordinary current density, which should not be exceeded in practice, is .01. This means that the maximum output should not exceed 4 amperes per positive plate

A cell will discharge many more ampere-hours than are given by this useful efficiency, and if the discharge be taken with a very small density the efficiency may reach a very high figure. Thus 95 and 98 per cent. have been obtained from small cells slowly discharged The efficiency of a cell therefore varies with its rate of discharge. If the efficiency, with an output of 5 amperes, be 90 per cent., it will be only 50 per cent. with a discharge of 40 amperes. Batteries drop in e. m. f. if the rate of discharge is high or the current density great. They should, therefore, be discharged at a slow rate. The most general maximum rate is found to be that which discharges a cell in ten hours. Thus the discharge of 15L cells should not exceed 30 amperes, nor that of 31L cells 60 amperes.

It is sometimes thought that because the e. m. f in charging is 25 per cent. greater than in discharging, there must be a loss of energy to that amount, but the fact is this loss of e. m f. is compensated for by gain of current, owing to the reduction in the internal resistance of the cell. The internal resistance of a cell, which is normally about .0003 ohm per positive plate, diminishes with the strength of the current of discharge, and therefore it is possible to get nearly all of the energy out of a cell that has been put into it The efficiency of a secondary battery increases with the lightness of the load put upon it, and in this respect it possesses a great advantage over that other transformer of electric energy, namely, the secondary generator of Gaulard.

It has been the practice to place the plates in a cell very much too close to each other This not only favors short circuiting but it prevents the free circulation of the electrolyte. Recent experiments have also shown that efficiency has also been improved by increasing the distance between the plates.

The character and the quality of the electrolyte used in secondary cells has scarcely received the attention it deserves. Hitherto scarcely anything but a solution of sulphuric acid has been employed. Experience seems to show that the best solution to use before charging is one which has a density of 1.150. Such a solution in a 15L cell, when fully charged, will acquire a density of from 1.210 to 1.220, and it is customary to maintain the density of the cells somewhat between 1.170 and the higher figure. One

of the great troubles with secondary cells that are imperfectly and improperly treated is the formation of the white sulphate of lead that is frequently seen upon both plates. In fact, it is the root of nearly all the i ls that these cells are heir to. There are many ways of getting rid of this sulphating. The plan used by Mr. Sayers, the engineer in charge of the St. Pancras Hotel installation, is described by him as follows:

"Our battery of 120 15L cells was rather badly covered with sulphate of lead. At first I simply charged them with the ordinary maximum charging current, 30 amperes, when each cell on becoming full would give about 2.5 volts. The sulphate, however, did not apparently move. I then tried charging with 40 or 45 amperes for a few weeks, and the change in the look of the plates—of the peroxide plate chiefly—was considerable. They began to exhibit patches of the well known plum-colored peroxide, and nearly all had the appearance of a peroxide plate covered with a lace-work of sulphate of lead. This lace-work, also, soon nearly entirely disappeared, and the majority of the plates are now looking very well. The e. m. f. of each cell, with 40 amperes charging current, is about 2.7 volts when the cell is milky. I have thought that this result was due either to the fact—if it is a fact—that sulphate of lead requires more than 2.5 volts to decompose it thoroughly—say 2.6 volts—or that the large quantities of nascent hydrogen attack the sulphate and combine, making sulphuric acid and lead."

It occurred, however, in 1886, to Mr. Barber Starkey of Aldenham park, near Bridgnorth, to see if carbonate of soda in the presence of lead had any beneficial effect upon plates liable to sulphating. The result was very satisfactory; all traces of sulphating disappeared. He treated his own cells in this way, and the effect was so decidedly advantageous to all appearances that I determined, after careful inspection and inquiry, to make an exhaustive experiment that should determine the question, and at the same time settle the best proportion to use. Six new 15L cells of the Elwell-Parker make were taken, and they were charged with solutions in the following manner:

No.	Sulphuric acid.	Sulphate of sodium.	Water.
1.	5 pints.	5 pints	15 pints.
2.	5 "	4 "	16 "
3.	5 "	3 "	17 "
4.	5 "	2 "	18 "
5.	5 "	1 "	19 "
6.	5 "	—	20 "

The sulphate of sodium solution was prepared by first making a saturated solution of carbonate of soda (ordinary washing soda), and then adding thereto sulphuric acid until effervescence ceased. The cells so prepared have been charged and discharged, and watched with great care from May, 1888, until the present day. We, therefore, have exactly twelve months' experience of their behavior, and there can be no doubt as to the beneficial result. The solution marked No. 5 is that which has given the best results, and after about six months' experience of its behavior two complete sets of 52 No. 23 L cells were charged, the one with the ordinary sulphuric acid solution of 1.175 density and the other with sulphate of sodium solution of 1.225 density. Six months' experience of these two sets has confirmed the result that immense benefit is to be derived from the sulphate of sodium solution. There has been no evidence of buckling; there has been little or no scaling. The bottoms of the cells are nearly as clean as when they were first discharged, while the bottoms of those charged with the sulphuric acid solutions have the usual accumulation of oxides of lead. Two cells were also and at the same time charged, the one with the sulphuric acid and the other with the sodium solution, and very careful tests of these two cells show that the addition of soda does not impair either the e. m. f. or the internal resistance, nor does it diminish the output of the cells. I have, therefore, come to the conclusion that the addition of soda has a distinct beneficial result, and it is my intention to use it invariably in future. The cells so provided remain in splendid condition. They can be left for months without developing any trace of sulphating or even of loss of charge. Carbonate of soda thrown into a badly-sulphated cell unquestionably leads to the rapid removal of the sulphate of lead, and this is supposed to be due to the fact that a carbonate of lead is formed which is easily reduced, and always produces beautiful deep puce-colored peroxide of lead.

The electrolyte that I recommend for adoption is this: To a quart of saturated carbonate of soda solution add slowly, during continuous agitation, 12 fluid ounces of strong sulphuric acid; fill the cell with water, 19 parts; strong sulphuric acid, 5 parts; soda solution, 1 part; total 25 parts. The specific gravity of this electrolyte should be 1.210.

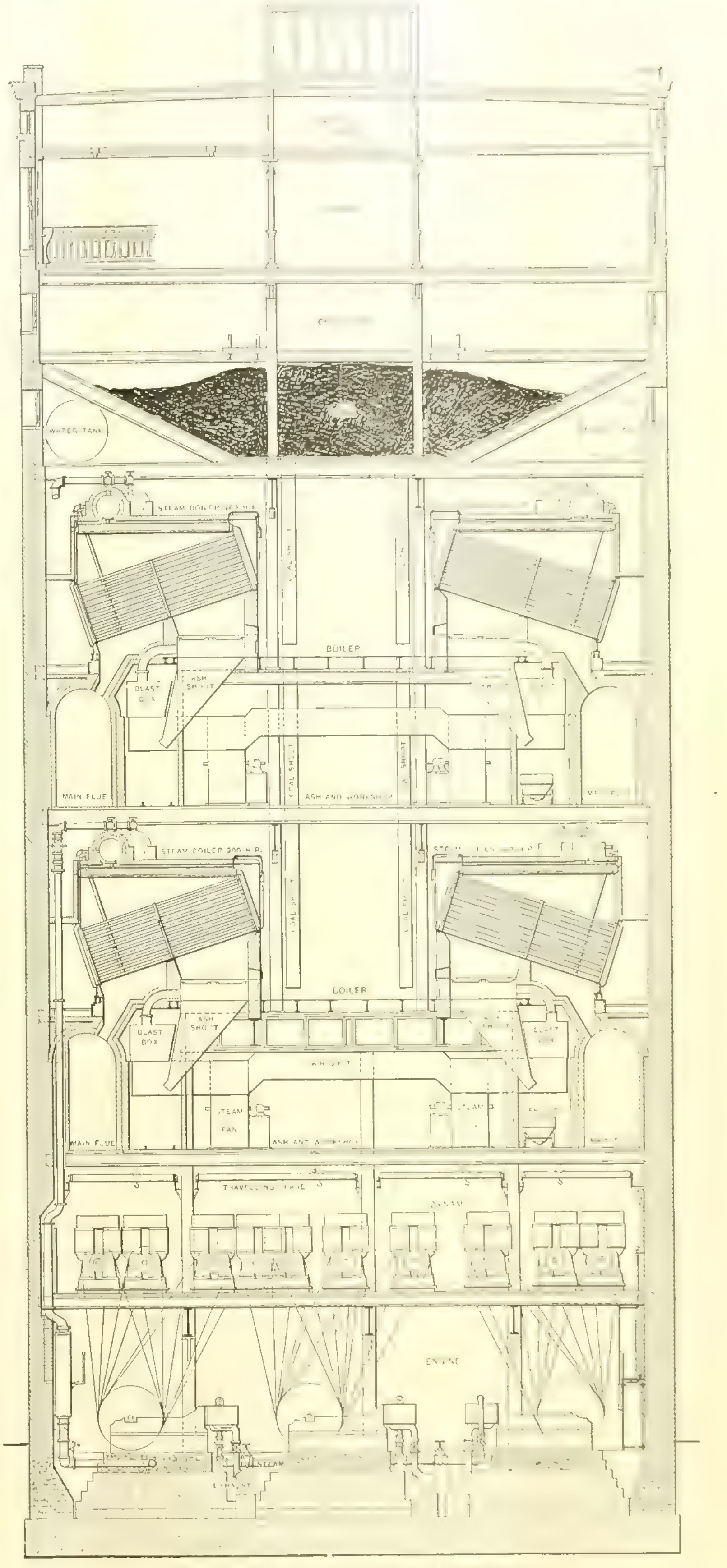
It is a mistake to use cells of too small a capacity for stationary purposes. This is usually done for economical reasons, owing to the capital expenditure involved in purchasing cells. Twenty-six 15L cells cost £78, and the same number of 23L cells cost £117, but I believe it to be true economy to expend the additional £39. Greater efficiency is obtained out of the larger cells now that soda has prevented injurious sulphating, for you are not limited to a minimum current as you are with the sulphuric acid solution. Small charging and discharging currents mean not only greater efficiency but greater durability of the plates. Secondary batteries used for telegraphy show no sign of disintegration. It is over-taxing cells that destroys the plates. Mr. Barber-Starkey's cells at Aldenham Park have now been in use for three years, and to all appearances they are quite as perfect now as when first set up.

An electric light plant is under way in New Birmingham, Tex.

Edison Electric Light Company's Station at Philadelphia.

The accompanying cut illustrates the new station of the Edison Electric Light company at Philadelphia. Reference to the cut will show that the engines have a [illegible]

[illegible]



EDISON ELECTRIC LIGHT STATION AT PHILADELPHIA.

tion on the ground floor, and are belted directly to the dynamos on the floor above. Steam for the twenty 500-horse power engines will be furnished by twenty-eight Root boilers arranged in four batteries of seven boilers each, and two batteries on each floor located in the stories above the dynamo room. The coal is received at hoists at the back of the building, where [illegible]

which is run by a two-cylinder engine attached directly to the fan shaft.

The blowers deliver into the blast boxes, from which the air, controlled by [illegible] operated by levers in front of the boilers, passes to the ash pits and through the fire, the products of combustion finding their way through passages to flues which extend along the [illegible]

the building and deliver into two chimneys at the rear corners. The ashes are delivered from the grates through chutes, to iron cars upon tracks below the lower floor. The cut shows the different floors *in situ*, and a general outline of the whole arrangement. The cut herewith presented is taken from the May number of *[illegible] Steam.*

Edison General Electric Company.

James B. Williams, president of the Edison General Electric company, recently organized under the laws of the state of New York, with a capital of $12,000,000, for the purchase of the Edison Electric Light company, announces that agreements have been signed for the purchase by the new company of the capital stock of the three manufacturing companies, payable partly in cash, and partly in the stock of the new company. The purchase price of the latter is equal to a capital sum on which the net earnings of the three manufacturing companies, as obtained from their books, show a net income of nearly 15 per cent. during the year ending November 1, 1888. It is proposed that for the present, dividends shall [illegible] on a part of the stock received by the shareholders of the Light company and the manufacturing interests in payment for their shares in the old companies; dividends on the remainder to be postponed until such future time as the board of trustees of the new company are of opinion that a dividend of at least 8 per cent. has been earned. The shares of stock in the new company on which the payment of dividends is to be postponed, will be deposited by the general company in trust with the Farmers' Loan & Trust company of New York city. That company will issue trust certificates to represent the shares of stock thus deposited, and whenever the board of trustees of the general company shall declare dividends on the entire capital, the trust company will on notice to all parties in interest redeem the trust certificates by distributing to the holders thereof the shares of stock of the general company held in trust. To provide cash for the immediate needs of the new company and for working capital, a syndicate has been formed to subscribe for stock in the new company, and in addition to the funds received therefrom, stock in the general company, to the amount of $2,266,650, will remain unissued for the present, available for use in the future, according to the requirements of that company. The shareholders of the Edison Electric Light company are invited to participate in this combination on the following basis: For each share of $100 of the capital stock of the Edison Electric Light company, deposited with Drexel, Morgan & Co., as hereinafter provided, the depositor is to receive $175 in the stock of the Edison General Electric company, carrying full rights as to dividends, and $91.66⅔ in trust certificates representing stock of like amount in the general company, on which dividends are deferred. Thus each depositor will receive a total of $266.66⅔ in stock and stock trust certificates of the general company for each share of Light company stock deposited, making a total of $4,000,000 for the entire $1,500,000 capital stock of that company.

CORRESPONDENCE.

New York Notes.

NEW YORK, May 18.—John Williams, of this city, exhibited the working of a package and freight delivery system at Boston Thursday, before many prominent scientists. The inventor claims that he can transport packages of mail or freight, or even passengers, in his electric car between Boston and this city in less than an hour. The device is a long, narrow car or box, with a wheel at each end fitting a single rail. At intervals along the track are placed hollow coils of insulated wire, through which a current of electricity is passed. The car itself is a magnet, and the principle upon which it operates is the tremendous power and rapidity which a wire coil exerts in [illegible] magnet [illegible] center. The power of each coil is automatically cut off when the car reaches that center and the next draws it forward, the whole being arranged so that the motion is continuous. Should the device work [illegible] over a limited distance, [illegible] newspapers and correspondents generally will be almost inestimable, and its [illegible] calculations of [illegible] experiment [illegible]

[illegible] plant for [illegible] fully in the [illegible]

Another subway explosion occurred in Union square this week, when the thoroughfare chanced to be deserted by pedestrians. A section of the roadway about three feet square at the corner of Fifteenth street and Broadway was blown up. It was caused by illuminating gas escaping into the conduit. Inspector Roth of the Board of Electrical Control said that the four electric cables in the subway were in perfect condition, and were not responsible for the explosion. He said that nearly all the gas mains along Broadway are leaking. The Electrical Subway board will hold a meeting next week, at which the subject will be thoroughly discussed, although the board has practically agreed that the only way to avoid explosions is to ventilate the mains by running pipes from the manholes to the roofs of buildings.

Mayor Grant seemed to feel discouraged and disappointed yesterday when the news from Albany was received and the death of his rapid transit measure was assured beyond doubt or hope. He said: "I am very sorry. The work of securing that which is the city's greatest need is delayed and hampered by this action. I have a strong personal feeling in the matter, too, for I wanted progress in this direction to be a monument of my term. I wanted to show the people that an honest railroad bill could be drawn, an honest commission appointed, and honest work done under it. But the subject will not be allowed to sleep. Although not able to do now what I should have liked to do, I can do something, and I will do the best I can. I do not know yet whether I shall appoint commissioners under the old acts or what I shall do; but I have no hope of anything from an extra session. Tom Platt's control of this legislature is absolute. I want my administration to be judged by net results, and I feel discouraged at the loss of the progress I expected to make in this direction." Before the matter can come up again for legislation it is hoped that a complete system of rapid transit will be developed by some electrical engineer that will commend itself to the people. W. H. T.

San Francisco, Cal.

SAN FRANCISCO, May 12.—The city council of Portland, Ore., has granted the Metropolitan Railway company a franchise for an electric motor line from the foot of Yam Hill street to the southern city limits. This road will be extended to River View cemetery, and eventually to Oregon City, twelve miles below.

The Willamette Bridge Railroad company has let contracts to the Sprague company for an electric road across the steel bridge at Portland, and will extend the road to Albina immediately.

The Transcontinental road, which held a franchise for a cable road in Portland, and which has off and on for the last two years been constructing its road bed for a cable system, has petitioned the council for permission to construct either an overhead or conduit electric railroad.

Rumors say that the Southern Pacific Railroad company is negotiating for the purchase of the San José electric road. This would indicate that this road would be turned into a cable road. The council, however, has granted the present management additional time to experiment. The company intends to try on a section of the road the Thomson-Houston or Sprague overhead system, which, if done, will probably kill off all prospects of a substitution of cable.

The trustees of Berley have passed an ordinance purchasing the Jenney plant which has been running there for the last year, for $24,000.

The electrician of the San Francisco Underground Conduit, Electric Light, Telephone & Telegraph company has applied for a franchise for constructing conduits throughout this city.

A committee representing the National Electric Tramway & Light company of Victoria, B. C., has been visiting Seattle to inspect the Thomson-Houston system at that place, and departed more than satisfied with its splendid working.

The Willamette Falls Electric company of Portland, Ore., has started in stringing wires between Oregon City and that place. A large and substantial station has just been completed at the falls at Oregon City.

Prof. N. [illegible] Leith has formed a company to manufacture and introduce his motors.

[illegible] lighted [illegible] moonlight only. When bids were requested for a renewal of the city contract, a fight [illegible] the Gas company and the Ball Electric Light company [illegible] not settled. The latter company [illegible] developments.

The Thomson-Houston company, through its Pacific [illegible] H. [illegible] has just closed a contract [illegible] alternating incandescent lamps, [illegible] Cal.

[illegible] started on her trial trip

last Tuesday, but as the electric light plant was not completed, a large number of coal oil lamps were used.

At the last meeting of the San Francisco Electrical society a lively discussion was started on the subject of electric motors. W. G. C.

Sioux City, Ia.

SIOUX CITY, May 18.—The aldermen who visited Chicago to examine into the method of street lighting by electricity returned well satisfied that Sioux City will save money by purchasing and operating an electric light plant of its own. They visited the works of three systems, and gathered information that will aid them in operating a city plant. They say that a plant suitable for use in Sioux City could be put in operation here for $35,000, not counting the power house. It is claimed 150 arc lights will supply Sioux City with all the light needed. The present system costs about $10,000 a year, and by lighting the lamps only when the almanac shows there is no moonlight, the city is many nights in total darkness. The arc lights can be maintained at a cost of $5 each per month, and be lit every night. That would make the system cost $9,000 per year, but the amount includes every expense, such as material, fuel, labor and repairs. The chances are that the council will interest a company of citizens to purchase the plant and operate it under a similar arrangement as the waterworks, the city taking the system as soon as it is able to assume the responsibility, which would be about the first of next year. R.

THE ELECTRIC LIGHT.

The Florence, Ala., Electric Light company will increase its plant.

The Loredo, Tex., Electric Light & Power company has doubled its capacity.

The Thomson-Houston Electric company is again enlarging its factories at Lynn, Mass.

The university of Tennessee at Knoxville will install an incandescent plant with a capacity for 150 lights.

The Mammoth Spring, Ark., Water, Light & Motor company will build an electric light plant and electric railroad at an early day.

The electric light plant at Goldsboro, N. C., will be erected on the Enterprise Lumber company's property, and receive its power from that company.

The Evansville Gas & Electric Light company of Evansville, Ind., has found it necessary to order additional Brush arc lamps to meet the demand for lighting in its city.

The Athens, O., Gas Light company has petitioned for the right to enlarge its powers, and to change its corporate title to that of the Athens Gas & Electric Light company.

The Hays City, Kan., council last week granted a twenty five-year exclusive franchise to the Hays City Electric light company. Lights are to be in operation within six months.

A representative of the Brush Electric company has just returned to Cleveland, bringing with him an order for a 600 light incandescent plant to be installed in the works of the Louisville, Ky., woolen mills.

The streets of Winchester, Va., were lighted by electricity for the first time this month. The occasion was celebrated by a great parade in which the local fire department and militia company participated.

The Colby Electrical Manufacturing company has been incorporated at Chicago, capital stock $100,000, to manufacture electrical and other goods; incorporators, E. J. Colby, H. J. Hayes, and F. W. Parker.

The Philadelphia representative of the Brush Electric company of Cleveland, Edward W. Tisdall, has secured another order for a 65 light Brush arc dynamo with dial and lamps. This outfit will be used for central station lighting.

The Louisville Bagging Manufacturing company of Louisville, Ky., has recently decided to introduce electric light into its factory, and has placed an order with the Brush Electric company of Cleveland for an incandescent plant complete.

Albert M. Benjamin, of Cincinnati, objects to the erection in front of his premises of a pole on which to string wires for conducting the current for electric lights. He filed suit last week in the Common Pleas court against Haus and the Brush Electric company, to enjoin the erection of the pole. Judge Outcalt issued a temporary restraining order.

The Washington, D. C., Electric Lighting company has been ordered by the district commissioners to pay the sum of $3,379.74 to contractor H. L. Cranford, in full settlement of his claim for work done by him in relaying the pavements over the company's subway. The company held that Cranford should have obtained this sum from the district commissioners.

The Hawkeye Electric company of Davenport, Ia., reports the following sales: Two 50-horse power generators to the Central railroad at Davenport; these dynamos are to be used in supplying incandescent lights and power, the railroad company having arranged a special circuit for this class of work; two 250 light incandescent dynamos to the city of Nickerson, Kan.; one 75-light incandescent outfit, one 2,000-candle power light

for the excursion steamer White Eagle, of the Hawkeye Steamboat company; 150 light incandescent machine to the Moline Wagon company; 10-horse power motor to Egbert, Fidler & Chambers of Omaha, Neb., 2-horse power motor to W. L. Patton & Co. of Denver, Col.

A Detroit paper says: The experiment of lighting railway carriages by electricity is making satisfactory progress on the Michigan Central. Two passenger coaches now run regularly between this city and Chicago which are fitted with Woodward storage batteries for electric lighting. One charge suffices for the round trip, and the light secured is much more brilliant than that of ordinary lamps. The element of safety is one of the greatest inducements for the introduction of electric lamps, as it is quite impossible for any fire to catch from them, while the oil lamp is a constant source of danger.

A Danville, Ill., reporter recently described a phenomenon which he says was "beautiful and grand." He says, "It was a brilliant globe of fire resting about midway on the electric wire leading to the tower on the public square. It was before the dynamos were put in motion, and was incomprehensible. The reporter ran around to th electric engine room and found the authorities at fault about the strange action of their machinery there. He told them about the globe of fire phenomenon, and when they went to the spot the wire was found burned in two and fallen to the ground. This was soon spliced and the engines started all right. There was no lightning in the rain cloud just passing, but there is little question but the affair was owing to electric conditions in the atmosphere."

The Cincinnati, O., *Commercial Gazette* recently scored the city authorities for failing to introduce electric light for street illumination. In the course of an interesting editorial that paper says: "In these days of electrical wonders, when electricity is used for so many purposes, one of which is light, it is amazing that the city of Cincinnati should stand where it did almost half a century ago in regard to the method of lighting the streets. Electricity is used in hotels and in public houses, but, with the exception of a few lamps maintained by private parties, the streets are dependent upon the gas lamps, and these give forth what might be called a dim religious light. It might more properly be said they are the thieves' delight, and a terror to policemen who desire to do their duty; for there is no better police protection than light. It is to day, we suppose, the worst lighted city of its size, or any size, in the United States. The system, too, while many times better than gas, is far more economical. In the matter of economy, therefore, Cincinnati is far behind. In the matter of light it is still farther behind. We have the experience of other places to guide us. The Board of Public Affairs is in the habit of visiting other cities to examine improvements in the line of street building. Why not take up this light question? It is surely a very important one. It is important not only to the comfort of the citizens, but also to their safety, and likewise to their pockets." The fact that the *Commercial Gazette* has always been friendly to the gas companies lends additional weight to its demand for a change.

THE ELECTRIC MOTOR.

At a recent meeting of the Cleveland city council, a resolution was adopted requesting the East Cleveland Railroad company to extend its electric system to the heart of the city at once.

An Omaha paper says: Dr Mercer is stringing iron rails along Twenty-fourth street for his motor railway and rumor, as unconfirmed as the Sibylline oracles, has it that the motor will mote to N street by August 1st.

A dispatch from Omaha, Neb., under date of May 17th, says: The Omaha Street Railway company to day let the contract for the equipment of the lines in this city with the overhead electric motor system, to be in operation within ninety days. The plant is to cost $250,000, exclusive of the track.

At a recent meeting of the city committee on street car franchises of New Orleans, Joseph Hernandez of the Carrollton road, asked for permission to install the Sprague system on his road. He stated that if the council would grant him the right to operate the system on St. Charles avenue, he would put up ornamental poles surmounted by a light all the way to Carrollton. He invited the committee to visit Chattanooga, and examine the system.

The New York *Sun* is responsible for the following: George Rust, conductor of an electric street car at Wheeling, W. Va., went on top of his car to adjust the running pulleys connecting it with the wire, and, slipping, grasped the wire to steady himself. He got a shock that laid him out senseless, and was about to be taken down for dead when his face was accidentally touched by the wire, and he was brought to life again, little the worse for his experience.

The Ross Park Street Railway company of Spokane Falls, Wash Ter., has adopted electricity on its new line. The Thomson-Houston company of Chicago has been awarded the contract for equipping the road. Two 80-horse power generators will be introduced, and six motor cars will be operated. The line will be four miles in length, and will be double tracked. The power house will be a model of convenience, and the plant will be one of the most complete in the country.

The Brush Electric company is making a specialty of powerful generators and motors for power transmission and distribution, and is taking large orders for them, not only in this country but also for foreign shipments. The latest contract announced is one with the Calumet & Hecla Mining company for five of the large Brush generators of 130-horse power, and five of the 80 horse power Brush motors. A power station will in this case be built above ground for the generators, and the motors will be [illegible] driving pumps under ground. The plant goes to the copper mine at C[illegible], Mich.

According to a dispatch from Indianapolis [illegible] Reitz, an electrician of that city, has invented a motor for propelling vehicles and street conveyances. The idea [illegible] been experimented upon in Europe at different times [illegible] has never resulted successfully, for two reasons: the insufficiency of the battery power and its derangement consequent to the rigorous shaking which travel gives it. These two faults Reitz is confident that he has overcome. The idea is to furnish a vehicle with electric motive power sufficient to run twenty four hours without recharging, and to so arrange it that its speed may be graduated to a less or greater degree. The battery will be placed under the seat, and will comprise six large cells."

In an editorial advocating the use of electric motors, the Cleveland *Leader* says: "The city needs rapid transit, and must have it in the near future if our present growth is to continue uninterrupted. That much is certain, and upon that point all agree. As to the best means of securing it, opinions are sure to differ. The cable system presents many advantages, but from an economic standpoint is highly objectionable from the fact that such a large per cent. of the power used is expended in running the cable, and such a comparatively small part of it in running the cars. The capital required to put in a cable road is also a large item, and these two facts make it tolerably certain that the cable system, while successful beyond doubt as a means of rapid transit, is not the one that will secure the cheapest transit, nor make a considerable lowering of fare a possibility in the near future."

It is only a question of time before all the street car lines in this city will be operated with electricity, since it has proven such a success on the Riverside line, says a Wichita, Kan., paper. The suburban line will in a few days be operated by a similar system. The machinery will arrive the early part of this week, and by next week the traditional street car mule will be consigned to a needed rest, and the electric system put in operation. This line will start from the junction of First and Main, and will run to the stock yards, packing houses, car works and Fairmount. A fifteen minutes' service will be adopted, which will considerably facilitate the company's business, and prove advantageous to the patrons of the line. When this line is completed it will give Wichita the largest number of miles of electric railway of any city in the world, and it is but another sample of the indomnitable enterprise with which it is blessed.

The Sprague Electric Railway & Motor company have closed contracts for the equipment of the following electric railways: Collamer line East Cleveland, O., 8 cars and 3 miles of track; Key City railway, Dubuque, Ia., 4 cars and 2 miles; Long Island & Newton, 2 cars and 3 miles; Plattsmouth, Neb., Electric railroad, 2 cars and 2 miles of track; Union electric railway, Sterling, Ill., 7 cars and 6 miles of track; Binghamton, N. Y., 4 cars and 5 miles of track; West Bay City, Mich., 8 cars and 5½ miles of track; Council Bluffs, Ia., 2 cars and 5 miles of track; Eau Claire, Wis., 6 cars and 4 miles of track. Work has been begun on the Stillwater, Minn., Electric road, which will be 5 miles long, and on which 6 cars will be operated. Operations will be begun at Cincinnati next week, when six miles of track will be constructed and 20 cars operated. In Tacoma, Wash Ter., 12 cars will be operated over 7 miles of track. The Sprague company will soon open a small line in Buffalo, N. Y., where its system is being introduced. Four cars will be operated over two and a half miles of track. The Sprague company's road at Atlantic City, N. J., is giving satisfaction, and so popular has it become that 8 new cars have been ordered.

There is a prospect of a lively corporation war in Allegheny soon, says a Pittsburgh paper. The East Street Plank Road company threaten to prevent the erection of electric poles by the Pleasant Valley Street Car company. The latter corporation has decided to operate its two routes—Pleasant Valley and East street—by electricity. With this object in view they are placing jointed gas pipe at regular intervals along the line traversed by the street cars. This work has progressed satisfactorily thus far, the first objection only being made at the corner of Liberty and Seventh streets some days ago. No sooner has this blown over than another row seems to be on the tap's. Almost the entire route is already planted with poles, the unpoled section being out East street, the outer end of which is owned by the Plank Road company. The latter corporation, it is said, objects strenuously to the erection of the electric poles, and some excitement is looked for when the work is commenced. Colonel William A. Stone, attorney for the street car line, when asked about the difficulty last evening, anticipated no serious trouble. "We have not asked the Plank Road company for permission to erect the electric poles," said he. "When we are ready to go to work we shall then ask for this permission, and I have no reason to doubt that it will be granted. Yes, we have always had pleasant relations with the Plank Road company."

One of the most successful electric railroads in the country is that of the Omaha & Council Bluffs Bridge & Railroad company, which has now been in operation since October 1st without a single break that has caused a protracted delay. The Thomson Houston system was adopted. The company is officered as follows: President, John T. Stewart; vice president, Guy C. Barton, second vice-president, N. W. Wells; secretary, Geo. F. Wright; treasurer, J. H. Millard, general superintendent, C. H. Reynolds. The present equipment consists of thirty four cars—twelve open or summer cars, and the others closed. The generators are of the Thomson-Houston type—two 80 horse power, and one 40 horse power—driven by two compound Westinghouse engines. In the power house is also a 20 arc light machine, used in lighting the bridge and approaches with lamps of 2,000 candle power. The [illegible]

[illegible]

THE TELEPHONE.

The Border Telephone company of Pleasanton, Kan., has been incorporated with a capital stock of $[illegible] directors, W. [illegible], George [illegible] Thorne of La Cygne, Robert Kinard [illegible] H. W. [illegible] of Mound City and [illegible] W. Blue and A. Blaker of Pleasanton.

A curious case was developed in Wheeling, W. Va., last week. At a session of the City Board of Health its president, Dr. J. A. Campbell, filed charges and specifications against Health Officer George I. Garrison, alleging that the health officer, upon being called up by the president of the board by telephone, broke out into a violent abuse of his superior, in which he applied several epithets of the most opprobrious nature. He used the telephone, it was asserted, because he was too cowardly to make the remarks in the doctor's presence.

The Nebraska Telephone company of Omaha controls forty three toll offices, twenty seven exchanges and branch exchanges, having over 4,000 paying subscribers, of which 1,423 are in Omaha, 320 in Council Bluffs, and 600 in Lincoln. The capital stock is $654,000, on which eight per cent. dividends were paid up to June 30, 1887, when the earnings were invested in improvements. December 31, 1888, a dividend of six per cent was paid. The net earnings last year were over nine and one half per cent. on the capital stock. The outlook this year is even more favorable than last. The rates charged are as follows: $[illegible] per year in Omaha, and $54 in Council Bluffs. In other exchanges, $30 to $54. The receipts from toll service amounted to $44.85 per mile.

THE TELEGRAPH.

At Tunnel Hill, Ga., on the Western & Atlantic railroad, can be found the youngest telegraph operator in the Southern states. His name is Willie Quinn, and he is but ten years of age.

Mayor Hay, Fire Marshal Freeman, Chief of Police Donelan and Alderman Frank, of Springfield, Ill., visited Joliet recently to inspect the fire alarm and police telegraph systems there. The capital city of Illinois is without a police or fire telegraph system.

E. P. Barrett commenced a suit in the Circuit court in St. Louis last week against the Western Union Telegraph company to recover $635.49 damages. He alleges that on October 15, 1888, he bought cattle at Denison, Tex., and drew on the First National Bank at Denison for the money, and telegraphed Holt, Payne & Co. of the Union Stock Yards, to have their bank notify the Denison bank to pay the draft, but that the message was not delivered, and hence the Denison bank refused to honor the draft, and he lost a portion of the cattle he had purchased.

A project has nearly matured for the construction of a new telegraph line by the Postal Telegraph company from Sioux City to Yankton and Sioux Falls, making a loop which will include the three cities as its principal stations. The Postal Telegraph company is now established at Sioux City, its nearest business point to Yankton and Sioux Falls. The company has a further design to construct a line from Yankton to Norfolk. Two or three Yankton men have been interested in the project, and are ready to demonstrate their faith by taking several thousand dollars' worth of stock.

Miscellaneous Notes.

D. H. Dorsett of the National Subway company has been trying to get a franchise from the city council for laying a conduit through the streets of Omaha, Ne[illegible]

Prof. Richardson, the District Chemist of Washington, D. C., was recently instructed to conduct an examination of the manholes and electrical conduits in that city, with a view of determining the danger from gas explosions. He reported no indication of the presence of gas in large quantities.

The electrical exhibition at St. Johns, N. B., will mark a new era in electrical interests in Canada. It will be the first electrical exhibition in the Dominion on a large scale, and will be one of the greatest ever held in America. [illegible] electrical company in America, as well as many [illegible] companies, will be represented, and the display will cover the entire electrical field.

Personal Paragraphs.

[illegible] Co., Philadelphia, was in Chicago last week.

C. D. Shain of the Cincinnati office of the Westinghouse Electric company, was in Chicago last week.

[illegible], New York, was a visitor at the Chicago Electric club rooms last week.

F. P. Kobbé, treasurer of the United States Electric Lighting company of New York, was in Chicago last week.

Willard L. Candee, treasurer of the Okonite company, New York, sailed May [illegible] on the "La Gascogne" for Havre. He will represent the Okonite company at the Paris Exposition. Numerous friends and a number of the members of the Brooklyn 23d regiment, in which Mr. Candee holds a captaincy, and a delegation from the New York Electric club, were on hand to bid him *bon voyage*. Among the floral pieces sent on board the steamer was one representing the Okonite trademark made up of carnations [illegible] yellow roses.

Business Mention.

The Microphone Carbon Battery company has established its headquarters at 112 Liberty street, New York city, where it has increased facilities for supplying the rapidly-increasing demand for its battery.

The Illinois Anglo-American Storage Battery company has opened an office at 95 Dearborn street, Chicago. This company is operating under patents of the Anglo-American Electric Light Manufacturing company of New York city. It claims for its battery high efficiency durability, economy and simplicity.

The Belding Motor company has installed motors in the following establishments in Chicago recently: Keen & De Lang, 232 La Salle street; J. J. Kenney, 228 State street; Chicago Shirt company, 199 Fifth avenue; Einstein & Co., Quincy and Franklin streets; J. W. Hall, American Express building; Northwestern Masonic Aid association, Home Insurance building; Spalding & Co., jewelers, State and Monroe; Schaefer & Roach, billiard hall, Clark and Quincy; Imperial restaurant, 256 Clark; Redpath billiard room, Monroe, near State; Parisian Suit company, State and Monroe streets; C. L. Palmer, 170 Madison street; Holstein & Co., 173 Adams street; W. J. Johnson, 182 Jackson street; Goebel & Co., 2[illegible]5 Madison street; Kohlsaat & Co., Jackson street place; Denis Ferguson, State and Monroe; Ducat & Lyon.

Electrical Patents.

Issued May 14, 1889.

403,0[illegible]2. Connector for Electric Railways. Leo Daft Plainfield, N. J.

403,100. Electric Alarm Clock. Thomas H. Grady, Brooklyn, N. Y.

403,104. Electrical Signaling Apparatus. Adin A. Hatch, Kansas City, Mo.

403,110. Electrically-Heated Vacuum Pan. Gail B. Johnson and Milbank Johnson, Elgin, Ill.

403,157. Method of Electric Welding and Shaping of Metals. Elihu Thomson, Lynn, Mass.

The invention consists in setting up or establishing a counter electromotive or counter electromotive force tendency in those parts of the work which form a shunt to the part or parts to be operated upon, or in which it is desirable or necessary to check the flow of current in order to use the current in the best or most economical manner, thereby concentrating or confining the current to particular paths, and in some cases, where a positive counter electromotive force is produced, even assisting the original or prime heating current.

403,158. Dynamo Electric Machine. Henry E. Walters, Schenectady, N. Y.

To avoid shifting the brushes and to maintain a constant non sparking point is the object of the invention, which consists, mainly, in providing an extra regulating magnet or magnets acting on the end or [illegible] armature outside the main field magnet [illegible]

[illegible] reads as follows: "6. In a dynamo-[illegible] the combination of the armature, the [illegible] magnet having coils in series with the armature, and saturated so as to prevent [illegible], and an extra coil [illegible] with the armature."

[illegible] Batteries. Charles [illegible]

[illegible] The combination, with [illegible] batteries and a switch [illegible] said secondary batteries, [illegible] around [illegible] having connection [illegible] with mechan[illegible]

[illegible]

[illegible] H. Hunter, Phila[illegible]

Of the fifty-four claims the 1st, 32d and 54th are given: "1 The combination of a sectional working conductor, the end sections thereof being curved and all the sections being arranged end to end, but insulated from each other to form a mechanically-continuous but electrically-interrupted conductor like a severed loop, switches at all the brakes but one to normally bridge from one section to the next and close the breaks, an electric generator, and connecting conductors connecting the working conductor sections on each side of the unclosed break in the looped portion with the two poles of the generator.

"32. In an electric railway, the combination of the traveling vehicle, an electric motor carried thereon for actuating it, a buffer and lever mechanism actuated by said buffer to change the relative position of the commutator sections with the brushes to reverse the motor, and a lock to retain said parts in their new relative position.

"54. The combination of two terminals of conductors brought close together, a pivoted switch adapted to close or interrup the circuit between said conductors, and a spring to resist the movement of the switch on starting to shift it, the said spring being positively connected with the switch, and assist it upon the last portion of its movement in being shifted."

403,193. Means for the Electrical Propulsion of Boats. Rudolph M. Hunter, Philadelphia, Pa.

Claim 2[illegible] reads: "The combination of a water-way, a line conductor, a traveling electrically propelled boat having a propeller acting upon the water and driven by an electric motor, and a current collecting device between the line conductor and boat, and connected to the boat at or close to its rear or stern part."

403,211. Magnetic Shield for Watches. Harry P. Pratt, Chicago, Ill.

403,244. Apparatus for Registering the Consumption of Electric Energy. Lucien Brillie, Paris, France.

403,250. Method of Reducing and Separating Magnetic Ores. John D. Cheever, New York, N. Y.

The invention consists in first heating the ore; second, crushing or disintegrating it while hot, and third, separating the magnetic from the non-magnetic particles by passing both together through a magnetic field.

403,253. Galvanic Battery. Charles Colle, Lille, France.

403,256. Device for Collecting Metallic Ores. Henry H. Eames, Baltimore, Md.

403,258. Vibratory Telegraphy. Stephen D. Field, Stockbridge, Mass.

The object of the invention is to provide means whereby a single transmitting key in the main line may be so controlled by subsidiary keys in branch or home circuits that its movements may be so timed as to produce on the main line resultant vibrations, which at a distant station in turn will produce results which shall correspond to the various keys which may have been closed at the transmitting station.

403,262. Covering for Electric Cables. Eben F. Garland, Lynn, Mass.

403,267. Insulated Wire. Salomon Heimann, New York, N. Y.

The second claim follows: "An insulating covering for electric wires, composed of soluble glass and glycerine and a coating of pulverized pumice stone and plumbago."

403,291. Exchange System for Telegraphs. James H. Robertson, Rutherford, N. J.

The first claim is: "In autographic telegraphy, the combination, with a number of conductors of different resistances extending from the subscribers' instruments to and terminating in a central office, of switching means for electrically connecting any two of said conductors, and equalizing resistances, whereby the combined resistance of any two conductors that may be connected with each other is made approximately the same."

403,292. Combined Telephony and Telegraphy. James H. Robertson, Rutherford, N. J.

The claim reads: "The combination, with an autographic telegraph, of a telephone, the secondary circuit of which is arranged in inductive proximity to the receiver electro magnets of the autographic telegraph."

403,308. System of Electrical Distribution. Edward F. Thompson, Elizabeth, N. J.

The invention relates to the class of electric circuits in which electric converters are employed for transforming currents of high potential into currents of a potential suited to operate the various translating devices connected therewith. The object of the invention is to provide convenient means for introducing the circuits into buildings and sub-stations and transforming the currents at or near the points where they are to be consumed; and it involves various improvements relating to the circuit connections and to the apparatus employed.

403,311. Electrical Measuring Instrument. Edward Weston, Newark, N. J.

The invention consists in combining with any form of index or pointer two scales in proximity to and indicating the extent of movement of said body, the said scales being similarly and uniformly divided, and corresponding divisions on said scales being marked and representing on one scale a unit or number of units, and on the other scale a certain fraction of said unit or number of units.

403,312. Portable Tangent Galvanometer. Edward Weston, Newark, N. J.

The principal novel features embodied in the instrument consist in the construction and arrangement of the [illegible] for preventing undue oscillations of the magnet needle; in the form of the ring magnet and its combination with the index mirror and standard.

403,316. Device for Holding Telephones. Samuel J. Adams, Detroit, Mich.

403,345. Rheostat. John L. Gish, Jackson, Mich.

403,352. Coupling for Underground Conduits. Wilmot Lake, Washington, D. C.

The invention consists of a two-part coupling for underground electric wire conduits, made in the form of a collar or sleeve for holding the ends of perforated conduit sections from displacement and so that the perforations will register with each other.

403,374. Electric Riveting Apparatus. Elias E. Ries, Baltimore, Md.

The invention comprises an anvil and a heating tool constituting the terminals of an electric circuit, which are bridged by the rivet itself during the operation.

403,376. Dynamo Speeder for Gas Engines. Newton Rogers and James A. Wharry, Terre Haute, Ind.

403,397. Incandescent Lamp. James Stewart, New York, N. Y.

403,418. Method of Protecting the Lead Pipe of Telegraph Cables from Corrosion. Arthur E. Colgate, New York, N. Y.

The claim reads: "The method of forming a coating of sulphide upon lead pipes, which consists in forcing sulphureted hydrogen into the conduit containing the lead-covered cables."

403,439. Electric Controlling Device for Elevator Carriages. William E Nickerson, Cambridge, Mass.

403,440. Electric Controlling Device for Elevators. William E Nickerson, Cambridge, Mass.

403,441. Electrically Controlled Elevator. William E. Nickerson, Cambridge, Mass.

403,442. Electric Controlling Mechanism for Elevators. William E. Nickerson, Cambridge, Mass.

The invention consists in placing upon the walls of an elevator well switch plates in circuits and in connecting to the carriage an index electrode to be operated by the attendant, and to be so made and arranged that it can be set to cause a break in the circuit at any desired floor, so that the attendant can control the motion of the carriage by simply turning the index electrode.

403,451. Electric Battery. John A. Barrett, Brooklyn, N. Y.

403,458. Multiple Switch-Board Testing Apparatus. John J. Carty, New York, N. Y.

The invention relates to multiple switch-board apparatus of a telephone exchange, and more particularly to the means of determining at one board whether a line called for is in use or connected at any other of the boards.

Claim 1 is: "The combination, with telephone lines connected each with a different switch on each of two or more switch-boards, of pairs of cords and plugs at each of said switch-boards, the tips of each pair being connected together, and the sleeves of each pair being connected through a characteristic current-producing device, whereby it may be determined at one board whether any line wanted or called for is in use at any other of the boards, the particular board at which the connection is made being indicated by the characteristic tone."

403,472. Printing Telegraphy. Zeroy P. Hotchkiss, Oak Park, Ill.

The invention is designed to print telegrams after the manner of typewriters, and to do this immediately, that is, to receive and print a telegram at the same time, turning it out of the machine ready for delivery. The invention is covered by twenty-three claims.

403,482. Insulating Tubular Iron Posts. William H. O'Beirne, Elgin, Ill.

The first claim is appended: "The insulator for tubular posts, consisting of the insulator block having oppositely-turned ends and intermediate annular flange, and the cup-shaped rain guard."

403,483. Testing Apparatus for Multiple Switch-Boards. Joseph J. O'Connell, Chicago, Ill.

The invention consists in providing a branch circuit to ground through a variable contact in connection with each pair of cords and testing apparatus for each operator at the different boards, consisting of a ground circuit, including a battery and a telephone or other indicating apparatus, by means of which it may be determined, on closing the battery to the test piece of any switch upon one board, whether the line with which said switch is connected is busy—that is, connected with another line upon some other of the switch-boards. The invention also consists in certain switching apparatus or loop key devices, by means of which the operator's telephone and the clearing-out annunciator are alternatively looped into the connecting cords.

403,484. Thermostatic Door Closer. William R. Patterson, Chicago, Ill.

403,487. Dynamo-Electric Machine. Frank A. Perret, Brooklyn, N. Y.

The second claim is given. "In a dynamo electric machine, a field magnet built up in layers of thin plates of sheet iron, each plate constituting in one piece a pole piece, a core, and part of the yoke, and pierced with bolt holes, in combination with bolts passing through all the layers and holding them in rigid relation together."

403,491. Insulating Device for Line Wires. Thomas J. Smith, Brooklyn, N. Y.

403,492. Electro-Medical Apparatus. Thomas J. Smith, Brooklyn, N. Y.

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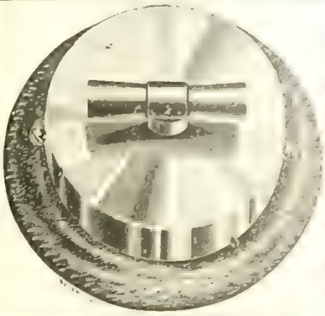

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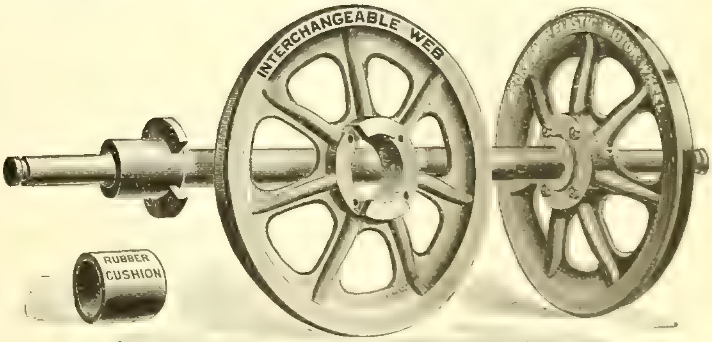

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Cincinnati Street Railway Co., Cincinnati, Ohio.
West End Electric Railroad, Boston, Mass.
Port Huron Electric Co., Port Huron, Mich.
Chihuahua Railroad, Chihuahua, Mexico.
Bushwick Railroad, Brooklyn, N. Y.
Broadway Railroad, New York.
Third Avenue Railroad, "
Jersey City & Bergen Railroad, Jersey City, N. J
Omaha Cable Railroad Co., Omaha, Nebraska
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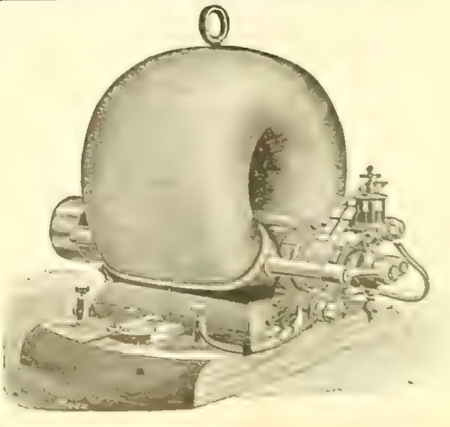

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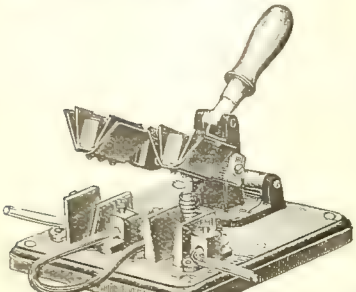
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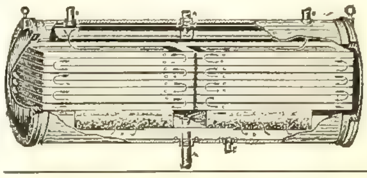
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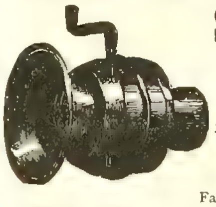
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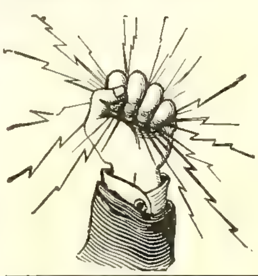
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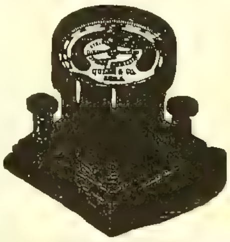
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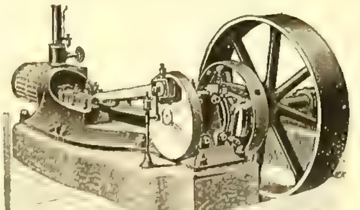

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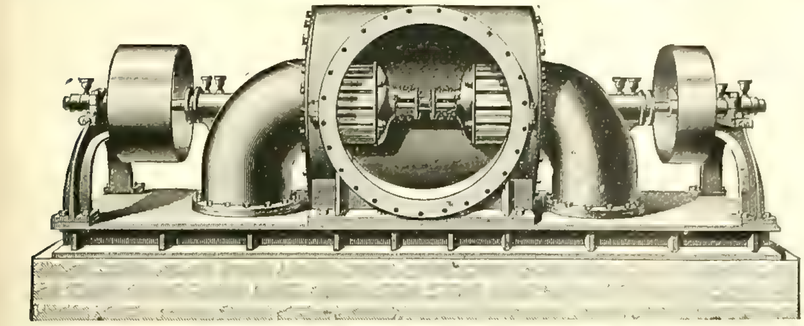

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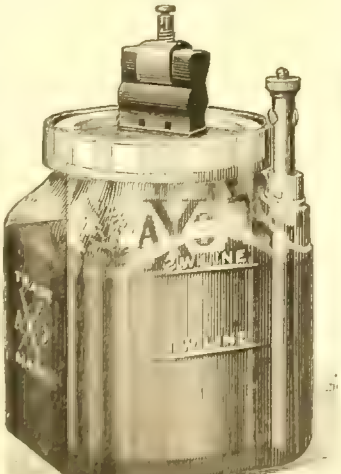

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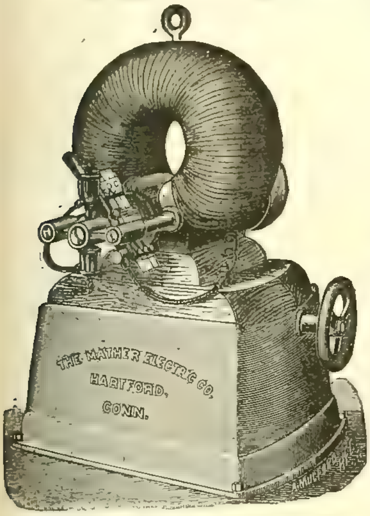

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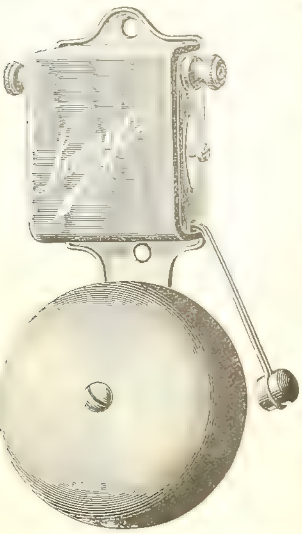

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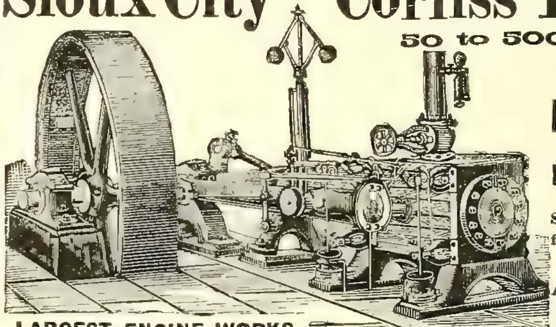

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1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simply a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

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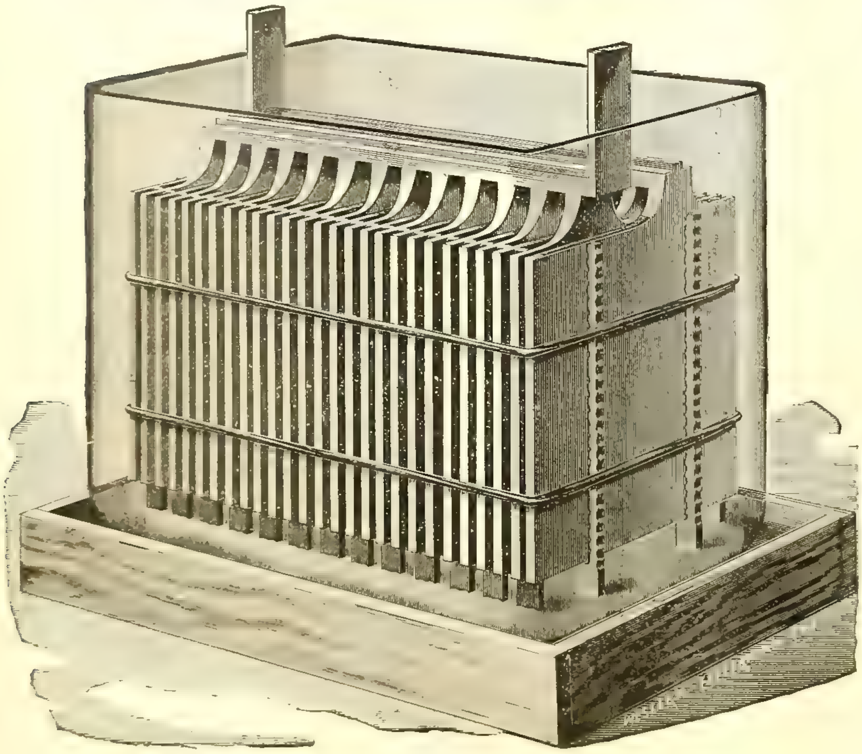

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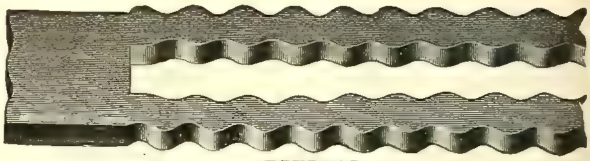

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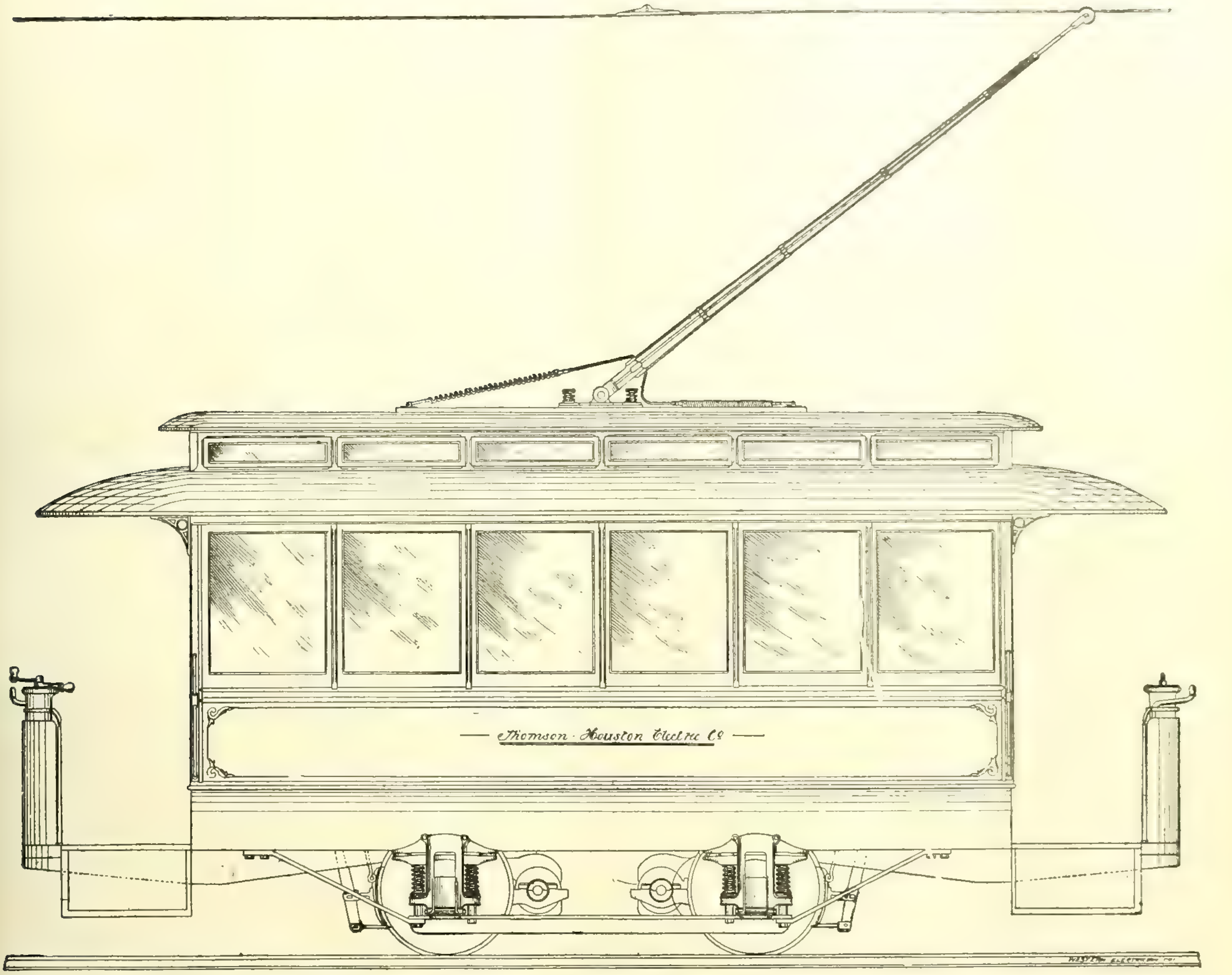

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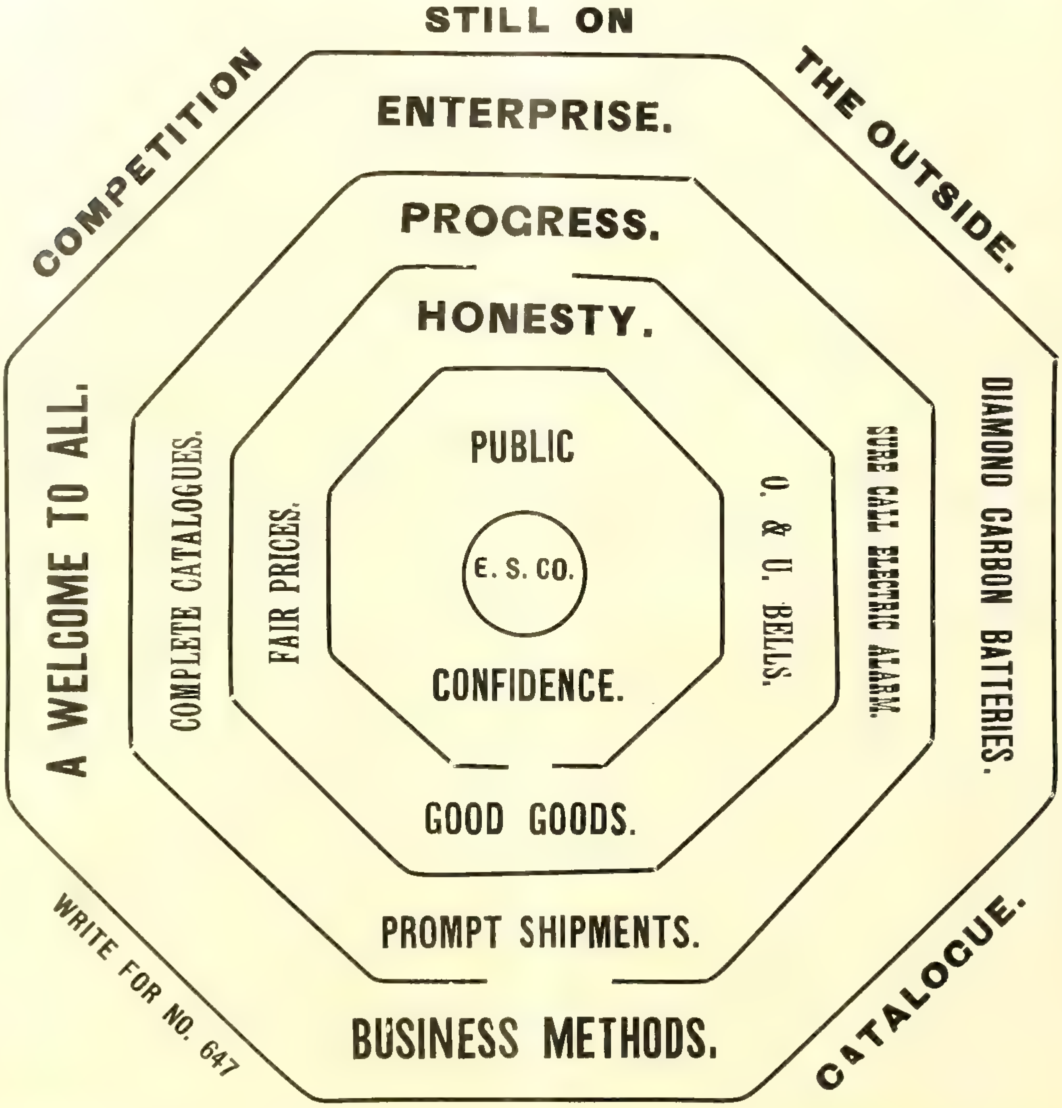

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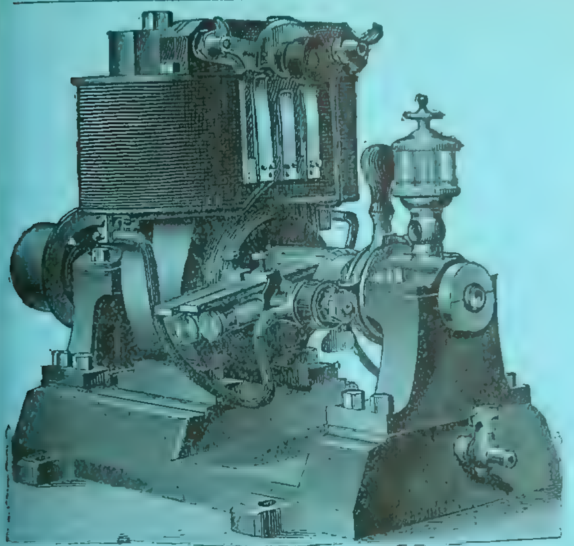

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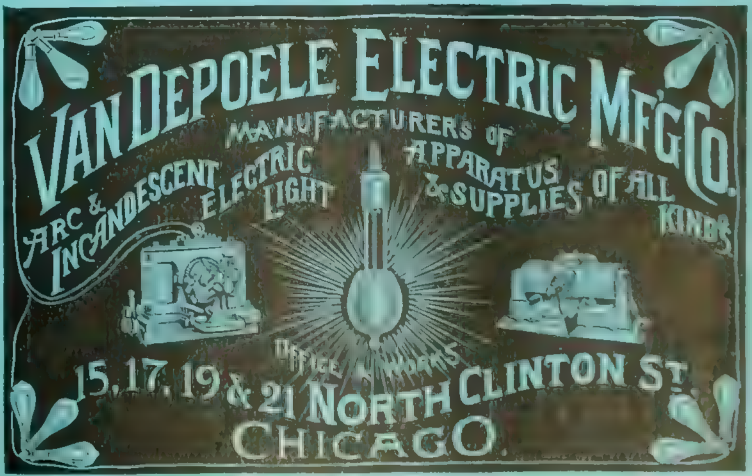

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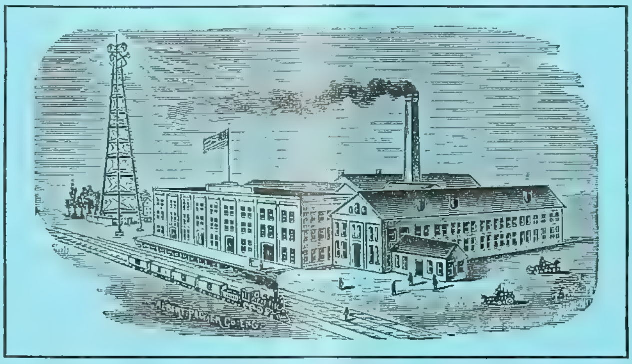

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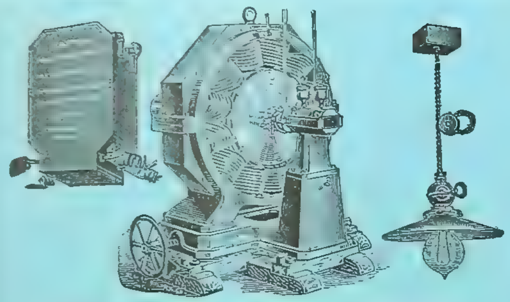

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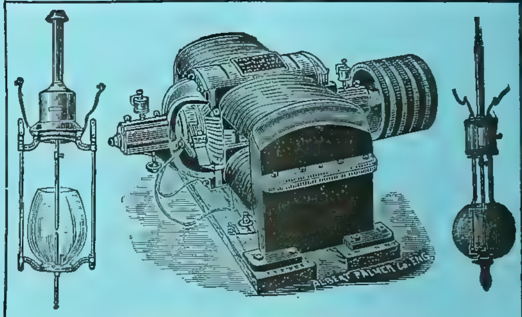

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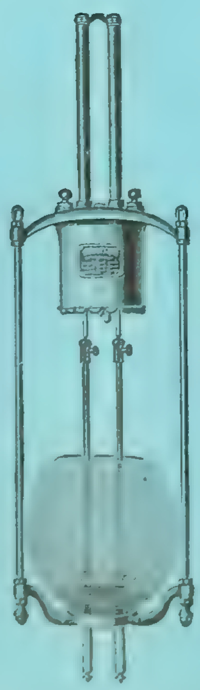

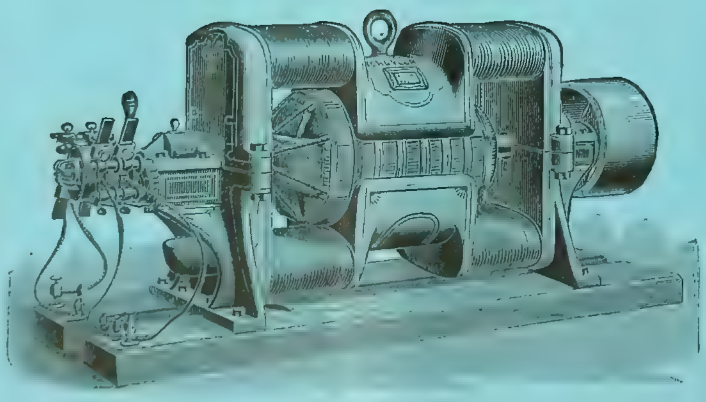

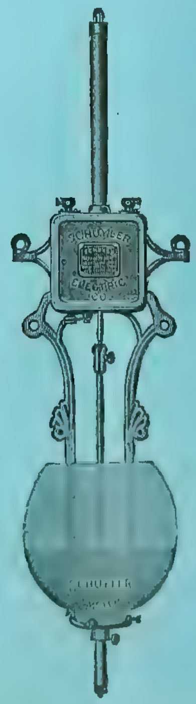

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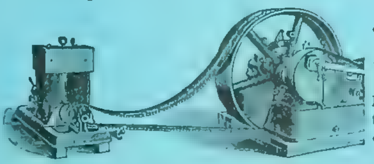

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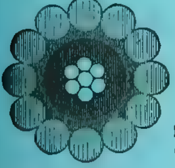

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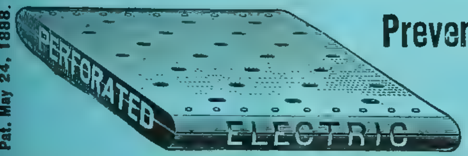

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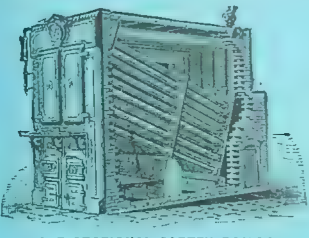

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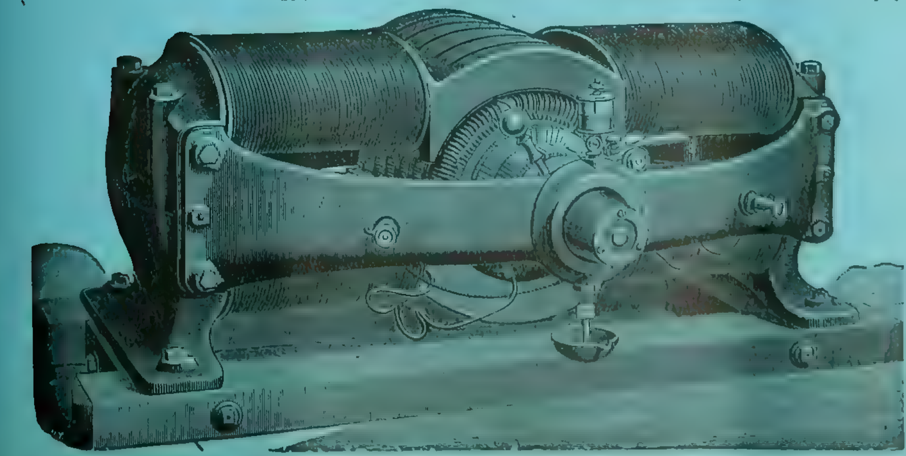

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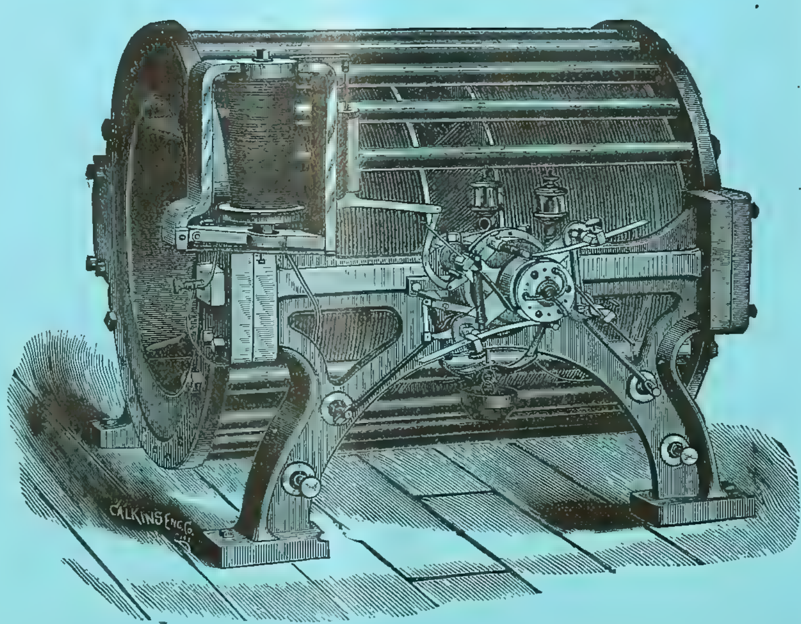

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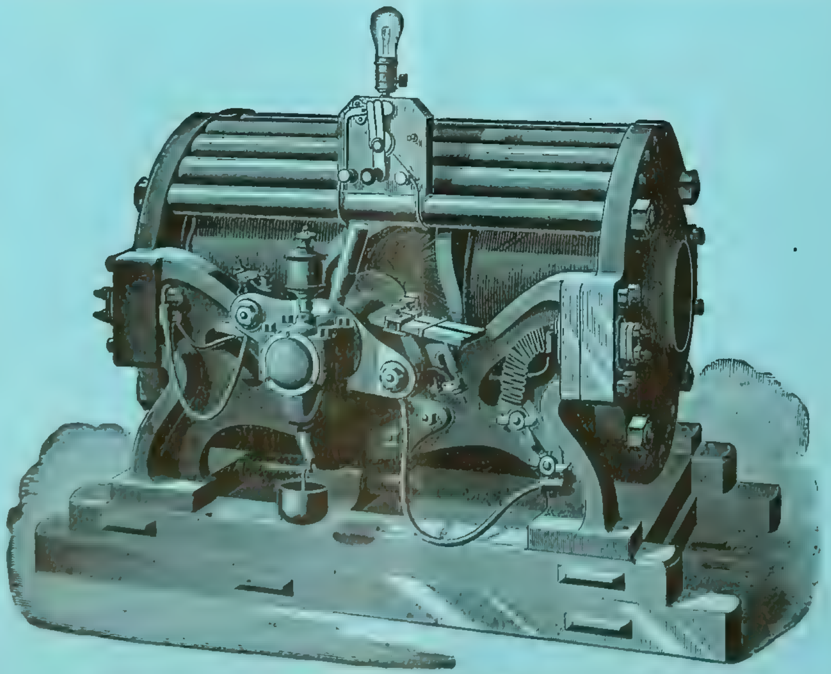

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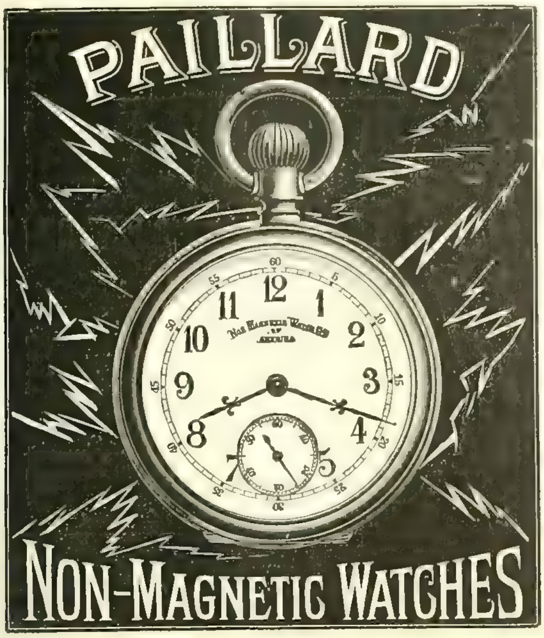

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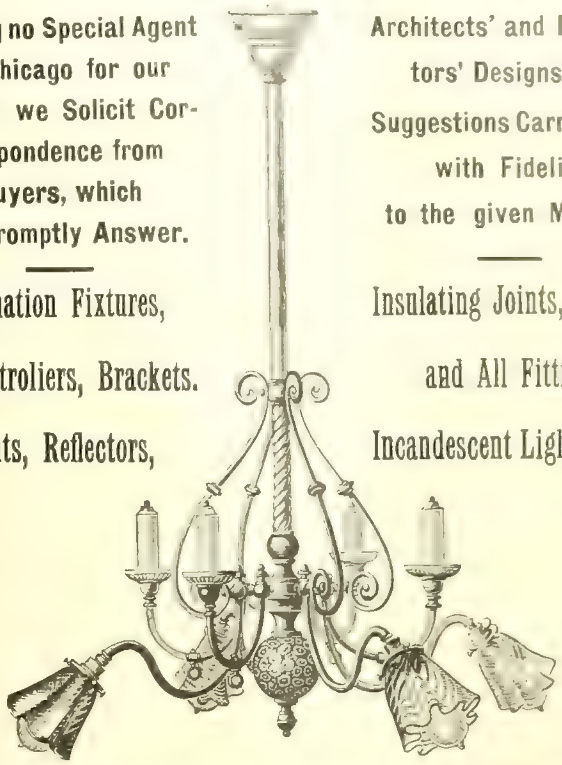

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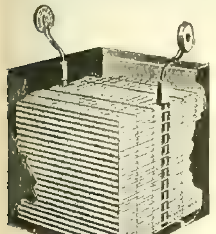

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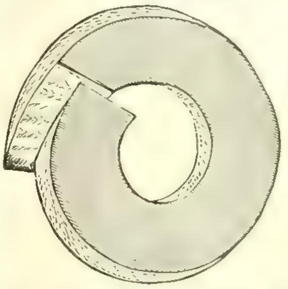

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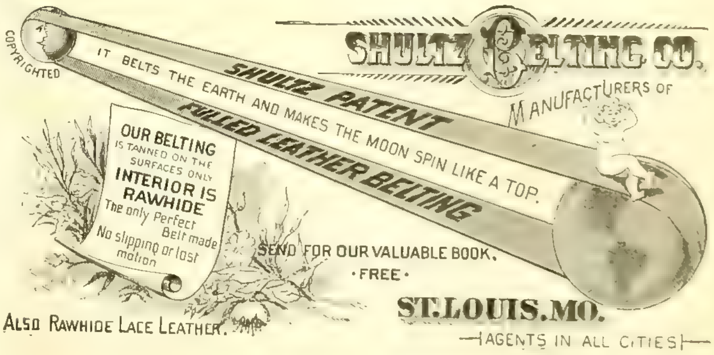

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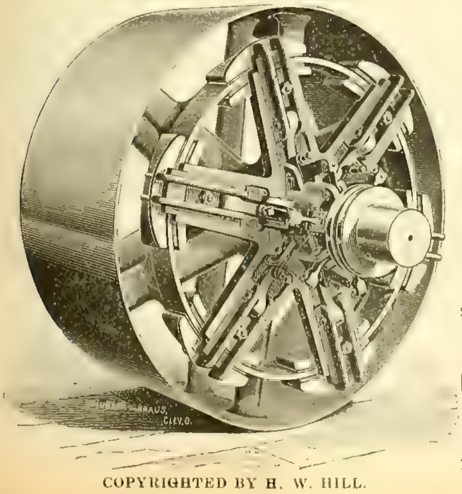

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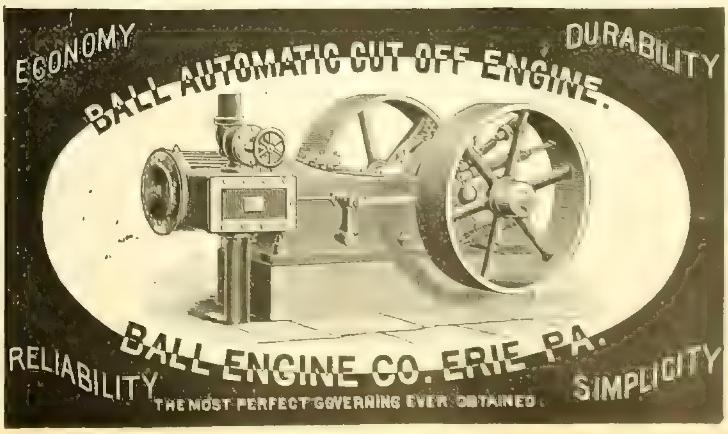

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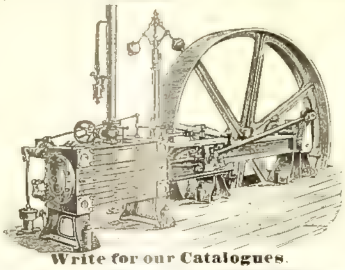

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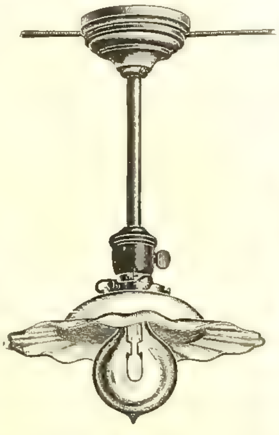

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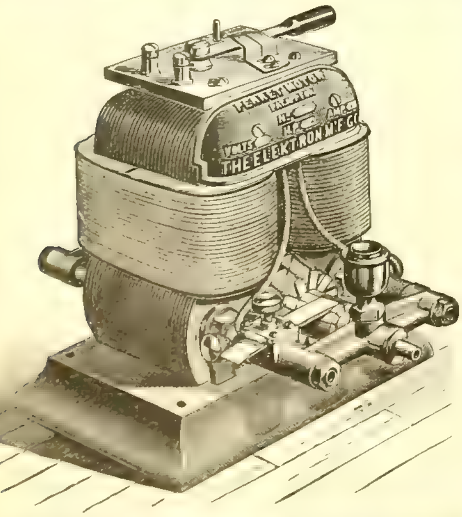

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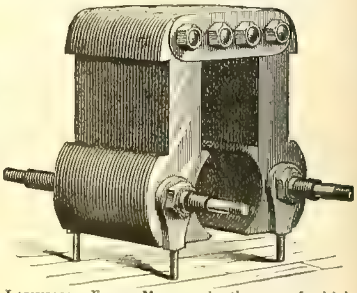

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His Patents Sustained by the United States Supreme Court.

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SUSTAINING THE EDISON PATENTS

In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

A QUESTION OF FACT.

Was, or Was Not, Edison the Original Inventor ?

This question has been decided in his favor a great many times, primarily by the U. S. Patent Office, which granted to him Patents bearing earliest dates; then by the various courts of Europe, through the crucial examination of which the question has many times passed.

Thus the QUESTION OF LAW having now been settled by the Supreme Court of the United States, and the QUESTION OF FACT by the highest experts of the world, this company now notifies the Public of its intention to call a halt and demand a reckoning for the trespass and abuse of its rights in

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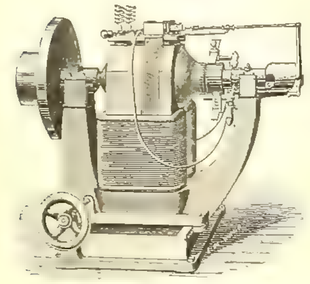

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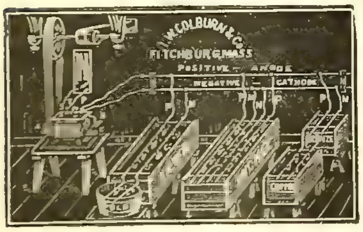

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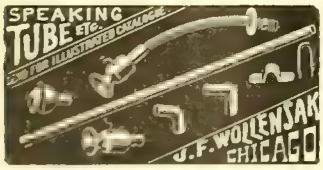

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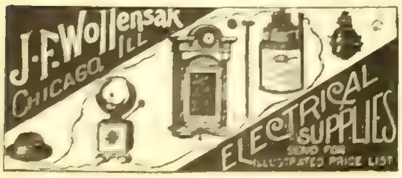

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Vol. IV. CHICAGO, JUNE 1, 1889. No. 22

Enos M. Barton.

A portrait of Enos M. Barton, of Chicago, is presented herewith. Mr. Barton is president of the Western Electric company, and is recognized as one of the ablest executive officers in the electrical field. To his efforts in a large measure is due the prosperity of the organization of which he is the head. It is a fact which is frequently commented upon, that many of the most successful workers in the electrical world to-day first entered the field by the telegraph office. It was so in the case of Mr. Barton. He was born in Jefferson county, N. Y., December 2, 1842. At the age of twelve he became telegraph messenger in Watertown, N. Y. While there he thoroughly learned the work of an operator. His knowledge served him in good stead. In 1859 he entered the University of Rochester, joining the class of 1863. He supported himself by night service in the local telegraph office. His duties were not always arduous, as his principal task, during a portion of the time at least, was, to use his words, "to report myself awake every fifteen minutes." Mr. Barton went to New York in 1862, and worked as a telegraph operator for a short time.

In his twenty-second year Mr. Barton resumed his work as a telegraph operator in Rochester. Salaries became reduced in the profession, and Mr. Barton entered into a partnership with George Shawk in electrical manufacturing at Cleveland, O. Elisha Gray, of telephone and telautograph fame, purchased Mr. Shawk's interest, and in 1870 Gray & Barton removed their business to Chicago. The firm formed the nucleus of the Western Electric Manufacturing company, which was organized in 1872. In the spring of that year the business of Gray & Barton was consolidated with that of the shop of the Western Union Telegraph company at Ottawa, Ill., and both were merged into the Western Electric Manufacturing company. Gen. Anson Stager was president, Mr. Barton was secretary, and Mr. Gray was the superintendent of the shop. The Western Electric company succeeded to the business in 1881, with a capital stock of $1,000,000. The history of the company since that time is too well known to require a summary in this connection. After the death of Gen. Stager in 1885, William S. Smoot was elected president of the corporation, and in the following year, after the latter's death, Mr. Barton was elected to fill the vacancy.

Mr. Barton is a man of marked business talent and judgment. He has an excellent knowledge of human nature, which has enabled him to select to fill the many responsible positions in the company, men of marked business sagacity. Mr. Barton's personal characteristics are such that he is extremely popular among his associates and acquaintances throughout the country.

ENOS M. BARTON.

Electrical Piano.

A curious throng of musicians gathered about an upright piano at Lyon & Healy's Chicago establishment one day last week watching the instrument intently as it produced popular airs and operatic selections in an artistic and almost faultless manner. The curiosity of the audience was awakened by the fact that the piano was producing all of these wonderful effects without any visible cause. The keys were operated before the eyes of the spectators, but no hand touched the key board. Many wondered if it was a manifestation of spirits musically inclined, others conjectured it was a new trick by Hermann, or some equally skillful prestidigitateur, while the expression on the faces of some of the older auditors indicated their belief that the instrument had become possessed of an evil spirit. But all misgivings vanished when the announcement was made that the instrument whose wonderful operations had excited so much astonishment, was an electrical piano. This explanation did not suffice, however.

"What has electricity to do with music?" was a query that suggested itself at once. This the gentleman in charge of the piano declined to say, as the patents on many portions of the instrument have not yet been issued.

F. W. Bailey, who is in charge of the piano, stated to a representative of the WESTERN ELECTRICIAN that the company controlling the piano, the Æolian Organ & Music company of New York, would begin manufacturing instruments as soon as a few minor improvements were completed.

The instrument is the invention of Robert W. Pain, an employe of the company. It differs in appearance from an ordinary upright piano only in the fact that it is a little deeper. This is necessary from the fact that the electrical apparatus must be concealed within the instrument. Each key is supplied with an electro-magnet. The presence of these magnets does not interfere with the operation of the key board the same as an ordinary piano.

The current to operate the piano was secured from four cells of Julien storage batteries, which are charged from the circuit of the Chicago Arc Light & Power company. A C. & C. motor was used. About [illegible]-horse power is required to operate the instrument.

A roll of paper, in which are cut numerous holes, is placed in an aperture in the piano just [illegible] The [illegible] paper [illegible] the [illegible] the [illegible] By [illegible] arrangement the keys are operated by mea[illegible] this device. How this is done, however, can [illegible] the machinery will not be explained until the pat[illegible] are issued.

Mr. Bailey [illegible] the company [illegible] turning out its instruments until it has teste[illegible] of the contemplated improvements, and satisfied the experts that the instruments are practically perfect.

The solution of this problem, in addition to the interest it possesses from a scientific standpoint, will have a wonderful effect [illegible] musical world. It has been asserted that it would be impossible to secure expression in playing difficult pieces, but musicians say the slight defects noticeable in the first pianos can easily be remedied. Much has already been overcome, and now the only difficulty is to insure artistic work in preparing the rolls of music. There are many advantages, of course, to be derived from the operation of the system by this means. In the first place a firmer stroke can be given the keys, and again, any combination of notes is possible.

The piano has been exhibited only in New York and Chicago. Lyon & Healy will soon have one of the improved instruments at their store.

Westinghouse-Edison Litigation.

The hearing in the interesting suit of the Westinghouse company against the Edison company, involving the patent for an incandescent electric lamp with textile or some other vegetable carbonated filament inclosed in a vacuum, was commenced May 21st at Pittsburg. The date of trial had been fixed for the 20th, but was postponed to the following day. The case opened with Associate Justice Bradley of United States Supreme court, and Judge McKennan of the United States Circuit court, on the bench. The Westinghouse company was represented by John Dalzell, T. B. Kerr, George H. Christy and George Shiras of Pittsburg; Edmund Wetmore, Hugh R. Garden, Amos Broadnax, Leonard F. Curtis and Frank L. Pope of New York, and J. Edgar Ball of Boston. The Edison interests were looked after by Major [illegible] B. [illegible], [illegible] Lowery, R. M. Dyer, W. K. Griffin, [illegible] Upton, and T. L. Blodgett of New York; B. B. Thurston of Providence, R. I., and Magnus Pflaum of Pittsburg.

Mr. Dalzell opened the case for the plaintiffs. He claimed that Westinghouse owned the Sawyer-Man patent, and that Edison was infringing. As is usual in patent cases, a great deal of technical matter, uninteresting to the outsider at least, was introduced. Mr. [illegible] claimed that until the Sawyer-Man [illegible] was devised there was no successful [illegible] lamp, and that as the Sawyer-Man and Edison lamps were essentially the same, the [illegible] issue was one of priority of invention. The Sawyer-Man, he claimed, antedated the Edison lamp by several months.

Mr. Lowery, in opening [illegible] stating that [illegible] claims of Edison's [illegible]

principles involved were all known and older than the lamp, and that there was a time in the development of the lamp when Edison was ahead of them all, he finally became personal in regard to an insinuation of Mr. Dalzell to the effect that the speaker had visited the Sawyer-Man shop, and on returning had communicated their ideas to Mr. Edison. Mr. Wetmore, one of Westinghouse's attorneys, arose to explain, and a little discussion ensued, but the matter was smoothed over, and Mr. Lowery continued. When court opened on the 23d Mr. Edison was in attendance. Mr. Lowery continued his argument, which was largely based upon the dates when the lamp was brought to more successful stages of its manufacture. He also gave a history of the various experiments of Mr. Edison bearing upon the lamp, and stated that Edison discovered that there must be a perfect vacuum in the lamp to produce a perfect light.

Mr. Lowery was followed for the defense by R. M. Dyer in a technical argument, in which he claimed that the character of the burner was not that which was to make the electric light a success, and if Sawyer and Man had discovered such a feature why was it kept secret.

The arguments in the case were finished on the 23d. Amos Broadnax, on opening for Westinghouse, claimed that the Sawyer-Man patents covered the one new thing in all the lamps, viz., the fibrous conductor. His whole argument was to establish the priority of the Sawyer-Man claim for the adoption of this fibrous conductor in incandescent lamps. A number of dates were quoted to substantiate his claims. The Sawyer letters, he stated, were contradicted under oath in Mr. Sawyer's testimony.

Mr. Edison's testimony was quoted to show that the latter did not use the fibrous con-[illegible]. Mr. Wetmore, in closing the Westinghouse argument, dealt more particularly with the personal character of the [illegible] Man lamp, stating that while a great deal had been said about Mr. [illegible] invented the entire incandes-[illegible] he intended to show that Edison was not entitled to all the praise which had heretofore been given him. Further-[illegible] the Edison repre-[illegible] bamboo fiber to be [illegible] filaments, that consti-[illegible] to be the only thing that could be used. Hundreds of thou-[illegible] been made and sent [illegible] material. Mr. [illegible] into the history [illegible] that Edison [illegible] conductor, and [illegible] and the [illegible] did not [illegible]

After an exhibition of a variety of incandescent lamps each side submitted papers, and the judges took the case.

New Electric Motor.

A standard set of electric motors has been designed by the C. & C. Electric Motor company of New York ranging in capacity from ⅛-horse power to 25-horse power. Until the company moved into its new quarters its work was more particularly devoted to smaller motors, but recently it has manufactured larger machines as standard commercial motors. The general design of the motor [illegible] shown in the accompanying [illegible]. Fig. 1 illustrates the 3 horse power motor and Fig. 2 a 15 horse power motor. The machines present a few peculiarities of construction. The field magnet cores are drop forged from [illegible], circular in shape and [illegible] with the shaft, oblong in cross section, and of a width equal to the axial length of iron in the armature. When bolted to the base and pole pieces they completely surround the armature, forming an iron-clad machine.

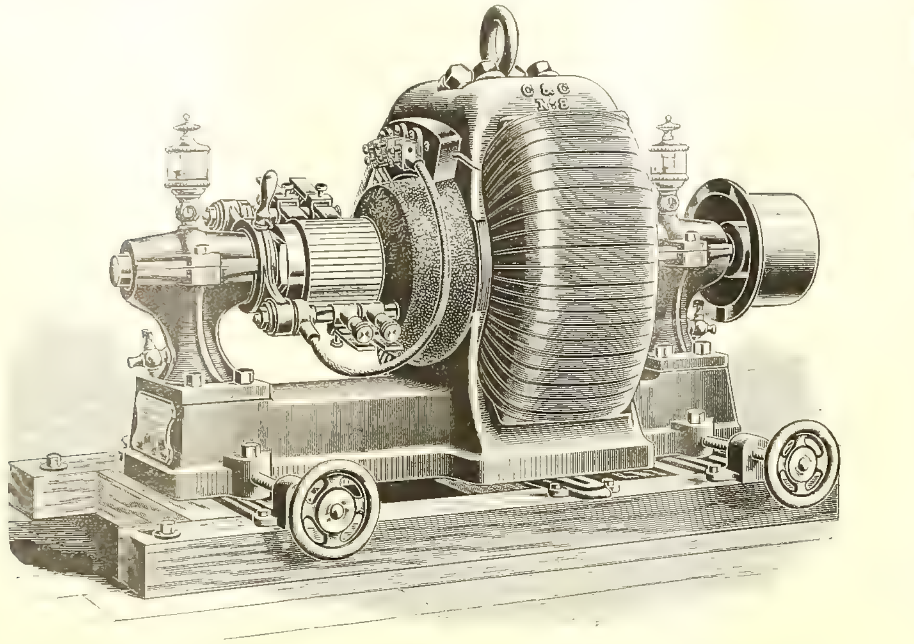


FIG. 1. C. & C. THREE HORSE POWER MOTOR.

The armature is of the drum type, and its general proportions are those of a Gramme ring in which the radial depth is increased until the annular ring reaches the shaft, forming a drum armature of large diameter. The general form of the machines require very little wire, and the air space resistance between the pole piece and the iron in the armature is reduced to a minimum.

The windings were calculated by dealing with the magnetic circuit as if it were an ordinary electric circuit, following Ohm's law, magnetic potential corresponding to volts, lines of force to current and the resistance of the iron when below saturation to the flow of lines of force, the same as the resistance of a wire to the passage of current. The circular form of machine gives the shortest possible length to the magnetic circuit, while the number of turns of wire necessary to develop a certain number of volts at a certain speed was determined by knowing the number of lines of force an ampere-foot of field wire would force through a magnetic circuit of a certain resistance.

Fig. 3 is the characteristic curve taken from a 3-horse power 110 volt motor, the ordinates representing the volts generated in the armature, the abscissae the amperes in field containing a certain number of feet of wire. The dotted ordinate is drawn at that point where the current flowing through the field produces the calculated number of ampere-feet necessary to develop the 110 volts in the armature. The machine comes out remarkably close to the calculations, the actual number of volts developed being 109 against 110 calculated.

These machines are constructed with great care to eliminate Foucault currents and undue heating. The friction load of a 15-horse power 110 volt motor recently tested, running free, was only 440 watts, while the total energy consumed was 704 watts. As yet the company has been unable to make any accurate efficiency tests under full load, but it is thought the efficiency will be high.

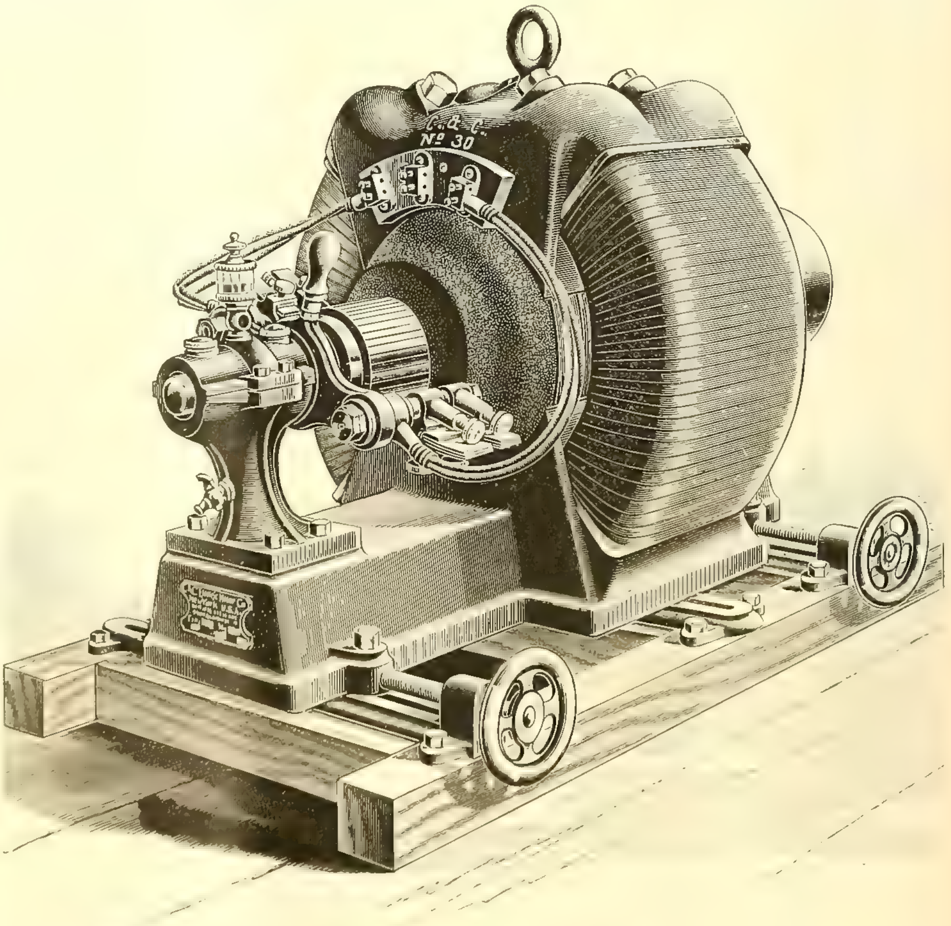


FIG. 2. C. & C. FIFTEEN HORSE POWER MOTOR.

Ellsworth Acoustic Telephone.

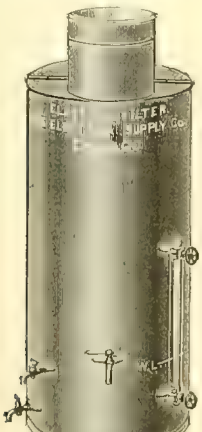
The transmission of sound over considerable distances by means of tense cords or wires, and by rods of wood, is a phenomenon with which the scientific world has long been acquainted; and long before the day of the telephone, a striking and always greatly applauded scientific experiment in the lecture hall was the telephonic concert, in which the sounds of a musical instrument played at a distance were transmitted by rods of deal, and made audible to an audience. The simple string telephone has long been known and used as an interesting scientific toy.

These experiments, though suggestive of possible practical applications, were not thoroughly studied by inventors interested in the subject of transmitting articulate sound, until quite recently, the electric telephone having probably overshadowed them. Of late, however, the subject of acoustic telephones has been intelligently taken up. Among the recent acoustic telephones which are thoroughly practical for a distance of two miles, is that of Messrs. Knudson and Ellsworth of New York. The cut shows the appearance of their telephone. The transmitting and receiving apparatus are identical. The essential feature of the system resides in the construction of the diaphragm, which consists of a disk made of thin interwoven strips of thoroughly seasoned wood, highly resonant, and which have been treated with an impervious varnish to protect them from the action of the moisture of the air. Connecting with this is the wire, which communicates with the other terminal of the station. This is formed of a twisted cable of special construction, which is claimed to have special merits for its intended purpose. An electric callbell for calling the attention of the parties at the station, completes the paraphernalia. With this simple combination, articulate speech is transmitted without difficulty around angles and turns.

The foregoing description is taken from the May number of the *Manufacturer and Builder*. The instruments are put on the market by the Ellsworth Telephone company of New York.

Ellis Oil Filter.

The Ellis oil cup, which the Electrical Supply company of Chicago has put on the market, is herewith illustrated. It is designed specially



ELLIS OIL FILTER.

for electric light stations. The filtration of oil has become one of the regular processes of electric light station work. It is claimed for this device that it contains all the requisites for perfectly restoring oils to their original color and grade after passing through the journal bearings of high-speed machinery. It is further claimed that this filter will require little attention, and the expense attached to operating it is but slight.

Mr. Edison is quoted by a Pittsburg paper as saying to a reporter in that city: "Electricity will be used on all the railroads some day, but the point is to get an economical engine. My theory is to have immense dynamos located all along the line of the road, and have the electricity conveyed from these stationary engines to the locomotives by wires through the rails. For example, I would put two big engines between New York and Philadelphia, and enough power could be furnished to whisk the limited at the rate of 100 miles per hour."

Ohm and His Law.

BY D. E. HUGHES [illegible].

This is the age of centennial celebrations, and our country has just passed through a celebration of the highest importance of this character. But there is one centennial which has been passed by without a celebration, and if it has been even thought of it has been by one or a few technical experts, whose studies have recalled it to their minds. It is that of George Simon Ohm, the discoverer of one of the most important of the laws which govern electrical science.

The exact date of his birth is in doubt. The

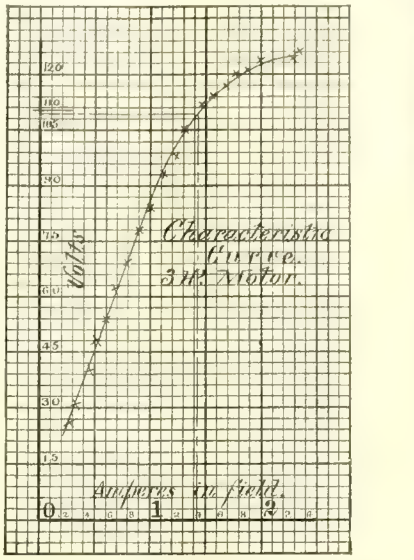


FIG. 3. CURVE OF THREE HORSE POWER C. & C. MOTOR.

day and month are not disputed, all authorities agreeing upon March 16. But the year varies widely. The Encyclopedia Britannica [Art. Ohm] gives it as 1781; Meyer's Konversations Lexicon puts it as 1785; Appleton's Cyclopedia and Brockhaus' Konversations Lexicon give it as 1787, while current newspapers have given the year as 1789. In the case of a man so famous as Ohm it seems strange that there should be such a discrepancy.

As to the date of his death there is not so much variation. The Encyclopedia Britannica gives it July 6, 1854, and all the other authorities July 7, 1854.

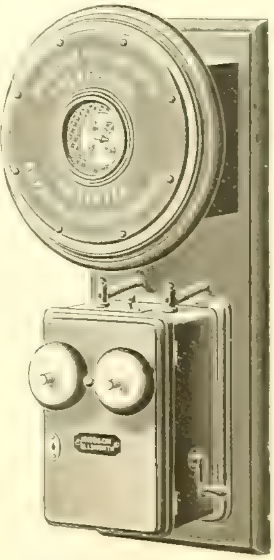
Ohm was the son of a locksmith in Erlangen, Bavaria, and in his boyhood, following the custom prevailing in European states, he worked in his father's shop. But very early in his life he turned his attention to physical science, and having been educated in the university at Erlangen and becoming an accomplished mathematician, he was in 1808 appointed professor of physics in the gymnasium in Cologne. In 1817 he became professor of mathematics in the Jesuits' college in Cologne, and in 1818 published his first work, on the "Elements of Geometry."

After a few years in Cologne he resigned his professorship and went to Berlin. He had become deeply interested in the phenomena of galvanic electricity. Galvani had discovered in 1790 that the contact of metals produced a current of electricity which developed muscular contraction in the frog, and in 1800 Volta had invented the Voltaic pile. Pushing his researches in these directions, by the aid of his mathematical attainments, Ohm became convinced that the flow of the electric current was governed by fixed laws, and he bent his energies to the discovery of those laws. The result of his studies was embodied in his famous work published in 1827 and entitled "Die Galvanische Kette mathematisch bearbeitet (the galvanic circuit mathematically determined)." This work was only a pamphlet, but its importance was far-reaching, for here is found what has ever since been known as "Ohm's Law," and the mathematical determination which he then gave has been the basis of the mathematical calculations of electric force ever since. Shortly after Ohm became the director of the Polytechnic School at Nuremberg, where he remained from

[illegible] until his [illegible] [illegible] tical Geometry," published in Nuremberg [illegible] [illegible] the [illegible] the German [illegible].

Ohm's law completely changed the methods of [illegible] force. Before his discovery the quantitative circumstances of the electric current had been very vaguely indicated by the words "intensity" and "quantity," but these words indicated nothing definite. By Ohm's law, however, it for the first time became possible, accurately, to define and measure electromotive force, strength of the current, and resistance. By a long series of experiments Ohm determined that the electromotive force, divided by the resistance, is equal to the strength of the current.

The writer of the article in the Encyclopedia Britannica says: "The merit of Ohm consists in having satisfactorily analyzed a great group of phenomena which had up to his time baffled all those who had attempted the task. How great his service was is easily seen when we remark the progress of those who adopted his ideas with those who for a time hesitated to do so. Ohm was guided in his mathematical work by analogy with the problem of the flux of heat, and introduced for the first time into the theory of the pile the equivalent of the modern word 'potential.' Ohm's word was 'electroscopic force' or 'tension,' and he showed that the fall



ELLSWORTH ACOUSTIC TELEPHONE.

of the *potential* is uniform along a homogeneous linear conductor. He considered that the potential was analagous to the temperature, and the flow of electricity to the flow of heat, so that the former just as much as the latter obeys the law of continuity."

Ohm continued a long course of experiments with the thermo-electric pile, and when he had become thoroughly satisfied as to the correctness of his theory he published his [illegible]. Like almost all other discoverers he was [illegible] time, and it was a long time before his theory was accepted. In every [illegible] science there [illegible] always [illegible] progressives and conservatives. In the early years of the present century electrical science was in its infancy, and the wonderful developments of the last twenty [illegible] years were [illegible] [illegible] were then [illegible] invented, but the [illegible]

[illegible] poses was still far [illegible] the electrical workers [illegible] Ohm's law, but as time passed on more and more came to recog- [illegible] and value.

[illegible] many and various were the devices employed to determine the amount of electric force in the current. Some of these devices were the wire of Jacobi; the mercury column of Siemens, a metre long with [illegible] metre, which at given temperatures, furnished units of resistance; the Daniell cell, which furnished the unit of electromotive force; the chemical unit of current intensity, and others. But none of these was satisfactory, for, being purely arbitrary and founded upon no law, they could not be accurately depended upon for nice experiments. Ohm's law provided a perfect system of unitation founded upon the fundamental units of time, mass and length. Subsequent experimenters who continued investigations on the basis of Ohm's law were Kirchhoff in 1849, Weber in 1851, the committee of the British Association for the Advancement of Science in 1863, Kohlrausch in 1870, and Lorenza in 1873. The result of all these investigations was to confirm in its fullest extent the discovery by Ohm in 1827, and in 1864 the British association gave the stamp of its approval by introducing a system of nomenclature, by which Ohm's name was perpetuated by being given as the name of a multiple of the absolute unit of resistance. This example was followed by the Paris Congress of Physicists in 1881, and now all electrical measurements are reckoned in ohms, amperes, volts and farads, after Ohm, Ampere, Volta and Faraday, the shining lights of electricity.

What electrical science may accomplish in the future, no man can foresee. The present is rich in electricians, who are continually enlarging the field of usefulness in this mysterious agency. Franklin drew down the lightning from the clouds, but modern inventors and dis[illegible]rers have subjugated it to such an extent that it furnishes us with light, heat and power. [illegible] manifold, but the ingenuity of man has already penetrated many [illegible] mysteries.

[illegible] opinion that all of [illegible] varying mani[illegible] [illegible]tle force, which, when dis[illegible] [illegible] natural [illegible] explained to us many [illegible] to our [illegible] prob[illegible] [illegible] As the [illegible] of the past, [illegible] nature's secrets will all be [illegible] [illegible]

[illegible]

The Wings Disk Fan.

The general application of the electric motor to the operation of [illegible] has had the effect of bringing many ingenious devices before the public. In the accompanying cuts the Wing disk fan is illustrated. Fig. 1 represents a fan operated by an electric motor ingeniously arranged, while Fig. 2 represents the fan operated by steam.

It is claimed for this type that it is peculiarly adapted to use in chemical works, drying rooms, mines and railroads as well as the ordinary uses, such as the ventilation of churches, schools, laundries, mills, etc. It requires very little power, and it is so light that it may be put on the end of a pipe in a wall, and can be run horizontally or perpendicularly as circumstances may require. It is claimed by the manufacturer that for general ventilation, the old method of ventilating by the natural currents or heated flues is not as reliable, and more expensive than by the use of these fans. For use in the arts, for drying, these fans have made a great change. By a small outlay in original cost and trifling expense of running the fans, the usual drying rooms can be made to do double the amount of drying, and in many classes of goods, such as woolen, silk, moroccos, etc., they come out much softer and in finer condition, and with less loss from shrinkage. For removing steam, vapors, smoke, heat, gases, dust, acids, ammonia, etc., from rooms or buildings, they do excellent work. The fans which are made by the Simonds Manufacturing company of New York, are put on the market in the west by W. H. Wissing, general manager, Chicago.

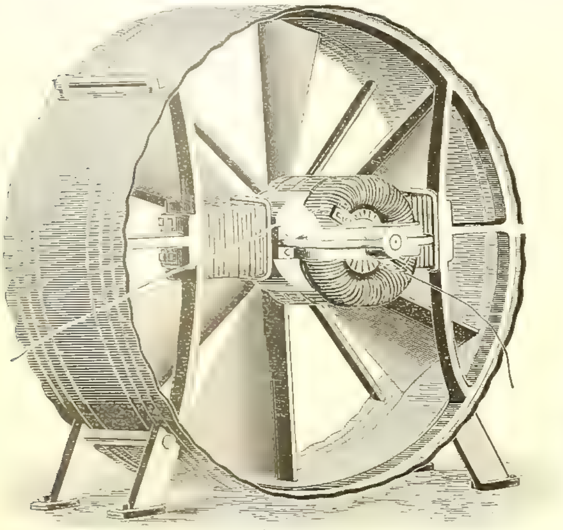


FIG. 1.

THE WINGS DISK FAN.

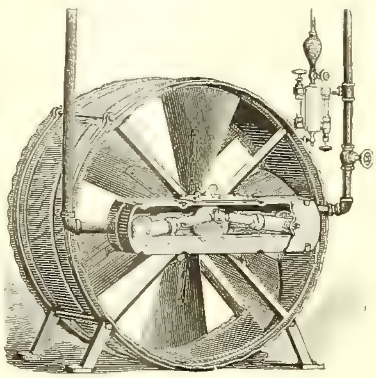


FIG. 2.

A New Electric Bell

A new type of bell is shown in the accompanying cuts. Reference to the working parts will show that it is [illegible] its construction. The bell is substantial, and the working parts are fully protected. Fig. 1 shows the outside of the bell, and Fig. 2 gives a sectional view. The bell is put on the market by Partrick & Carter of Philadelphia.

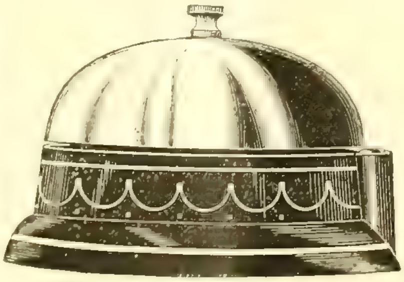


FIG. 1.

NEW ELECTRIC BELL.

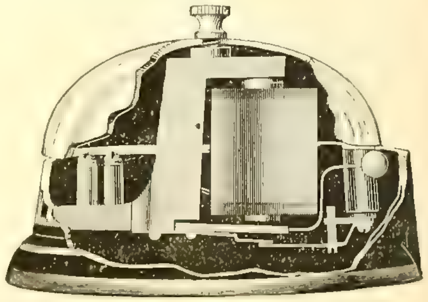


FIG. 2

The London [illegible] has made this discovery [illegible] of electric motor work in the [illegible] by electric motors are men[illegible] at Washington and at Force Bain in the state. [illegible] been named after the genial Force Bain of Chicago.

Secondary Batteries.

By William Henry Preece.

PART II.

The chief secret of the successful working of a set of secondary cells is careful and regular attention to their behavior, and the immediate remedy of any defect that may develop. They require daily testing and inspection. My battery is tested every morning for e m. f. by means of a Cardew's voltmeter. If the total number of volts divided by the number of cells is not over 2 per cent., each cell is tested separately by a portable Walsall voltmeter, graduated to tenths of a volt, until the defective cell is found. This has very rarely happened—in fact, only once during the past twelve months, when a plugging fell out, rested between the two plates, and short-circuited the cell.

Six cells are also tested every morning for density by a hydrometer, which is recorded in a book. The six cells are changed every month, so that each cell of the battery passes through this ordeal three times a year. The regular rise and fall of the specific gravity of a cell is the very best criterion one can have of its good working.

The normal density when the cells are charged should be 1.220. They fall 1 for every 5 ampere-hours taken out, and when they reach 1.150 they are exhausted. The density is thus a record of the energy that has been taken out, and of that which remains in

Occasionally I test them for internal resistance, both when charging and discharging. In the latter case the discharge current into the house is regulated by lamps to give 10 amperes when the e. m. f. (E_1) at the terminals is read. The e m. f., when the ends are free (E_2), is also read. Then

$$\frac{E_2 - E_1}{10} = \text{internal resistance.}$$

I make the current 10, for the internal resistance varies with the current, and by always using the same current I have an accurate comparison. The internal resistance of my 15L cells is usually .0012 ohm per cell when discharging, and .005 when being charged.

When a cell becomes defective by short-circuiting or any other cause, the plates are taken out, their faces scraped and straightened, the solution cleared, and the cell thoroughly cleaned. The cell is always benefited by such a process, for the cleaned cell is always the first to come up to the charge by as much as 1½ hours.

In charging cells there are three distinct indications that the cell is fully charged:

1. The e. m. f suddenly rises up to 2.5 volts per cell.
2. The hydrometer indicates 1.220.
3. The electrolyte becomes milky by the fine bubbles of gas that float in the disturbed solution during their gradual ascent to the surface and escape into the air.

The rise of bubbles of gas to the surface and their bursting scattered a considerable amount of acid spray about in the battery room, which was injurious to metals and apparatus; but F. Higgins showed how to prevent this by covering the cell with a fine net or calico. Glass plates are now much used instead of calico, but I have adopted Henry Edmunds' plan of pouring upon the surface of the solution melted paraffin, which solidifies and coats the surface with a uniform thin layer of what looks like ice.

It is necessary to be cautious in approaching cells with naked lights when they are being charged. There are several instances of explosion and injury to person in consequence

The chief defect of the negative plate is that the plugging scales and falls off in thin flakes. This, in the recent types, falls harmlessly to the bottom, but it should not happen at all, and it is due either to imperfect material or to hasty formation. The negative plate should certainly last for ten years. The positive plates also disintegrate, and to a much greater extent. The disintegration of the lead peroxide seems to be a necessary consequence of the action of the cell It varies with the rate of discharge. If the cells be worked heavily it occurs rapidly, but if the maximum rate of the output of about 4 amperes per plate be adhered to, the duration of the plate may be taken to be three years. The decay of the positive plate seems to occur almost entirely in the lower half of the plate, and this is probably due to the greater density of the solution favoring unequal distribution of current.

The secondary battery lends itself admirably under certain circumstances to the economical distribution of electric currents from central stations. It is possible to lay down a long main circuit of small dimensions, conveying a direct current of high e. m. f. which at different points can charge a secondary battery of a small number of cells, so as to "transform" the dangerously high e m. f. into one of a low and harmless character in the building to be illuminated; in fact, this is now being done in Chelsea by two different companies. The one company distributes its currents to the houses from sub-stations, where the batteries are kept and maintain a continuous supply of electric

energy. Each sub station, of which there are three, supplies current for 2,0[illegible] 50 watt [illegible] power lamps. There are 265 31 L cells, divided in two sets of groups of fifty-three. Each set is charged separately and alternately in series from the central generating station. While one set is being charged the other is supplying currents to the consumer. The main charging current of 60 amperes has an e. m f. of 500 volts per distributing station, or 1,500 volts for the present circuit; and the secondary discharging supply into the houses has a pressure of 100 volts. This system of distributing currents from batteries has many advantages. The currents being direct are available at once for motor purposes, as well as for lighting. The currents being so steady and uniform add to the durability and life of the lamps. The supply being continuous day and night, it is always available, just as is the light from gas. The distributed currents being of low e. m f, absolute safety to person is secured in such a system. The engines at the central station, being always worked at full loads, can be worked under their most economical conditions, and as they can be worked continuously throughout the twenty-four hours, a minimum capital expenditure in engine plant is necessary. It has already been pointed out that the efficiency of the battery is not much affected by variations of its own load, and that whether one lamp or 100 lamps be used, it is of not much consequence to the cell; in fact, the efficiency of the lighter load is the lightest. On the other hand, it must be pointed out that there is a considerable capital outlay required in batteries. The depreciation of the cells is very considerable, and there is an appreciable loss of energy at each transforming point. The maximum efficiency of batteries in practice rarely reaches 70 per cent., while less than 15 per cent. for depreciation can scarcely be allowed with prudence. The batteries for 1,000 lamps cost £1,325, or 27s. per lamp. The reliability, constancy and permanance of the light from batteries compensates for many another evil. The other company in Chelsea places the batteries in the houses, and charges 1,000 E. P. S. 31L cells over a circuit of nine miles.

There is a central station in Detroit, in the U. S. A., also distributing by batteries, giving great satisfaction.

The Kensington court central station, established by Messrs. Crompton & Co, and that at Whitehall court, also use secondary batteries, but the batteries are in the stations and not in the houses. They are used more for regulation and for reserve force purposes than for distribution.

There is also a large central station at Vienna, and one at Darmstadt, of the same character.

An extremely ingenious mode of distribution has been proposed by Henry Edmunds. The battery is divided into four groups. Three groups are jointed in series, and supply energy to the house, while the fourth group is in the main being charged. These groups constantly and continuously change places every three minutes by means of an automatic switch. A third of the battery is, therefore, always being charged, and this means that only one-third engine power is needed at the central station, and only one-third of the e. m. f. on the changing main. Mr. Edmunds' automatic distributer is an extremely ingenious apparatus, but it has not yet received the test of practical trial, though the sooner it does so the better.

Mr. Preece concluded his paper with a few remarks upon the application of secondary batteries to electric traction, portable lamps and telegraphy.

The Allen Transmitting Device.

Henry E. Allen of Chicago has recently invented an electrical transmitting device for rapidly conveying small packages, such as mail matter, from one place to another. Mr. Allen's apparatus is simple, and consists of two elliptically shaped metallic boxes, six feet long, placed parallel. The diameter of these boxes the long way of the ellipse is eight inches and the short way five inches. To each end of each box is fastened a pair of metallic arms, the latter being suspended from the axes of two wheels about two feet in diameter. The machine is saddled upon an angular track, as shown in Fig. 1, a box being suspended from each side. *B* indicates the metallic boxes; *a* the arms supporting the boxes; *A* the wheels, and *C* the angular track.

The track rests on iron gudgeons fastened on the top of high poles similar to telegraph poles, placed a little over 100 feet apart. The poles are marked *P* and the gudgeons *E* in the cut. A wire cable runs in the hollow part of the rail, just beneath the upper surface, upon which the wheels run. It rests on the tops of the iron gudgeons, the latter being carefully insulated. The cable is marked *C'* in the cut. The wire marked *W* is for the return current, and completes the circuit. In one end of one of the metallic boxes is a small electric motor.

Fig. 2 gives a view of the machine looking directly from above. The small wheel *c* runs along the side of the rail, and carries the current by means of the wire *b* to the motor. The circuit is completed by a trail wheel, *D*, which runs on the return wire. This wheel is connected with the motor by a wire, which passes through the box. The motive power thus generated is conveyed to the large forward wheel by means of a belt marked *a* [illegible] runs upon the wheel marked *d* [illegible]

The machine is stopped by a tripping device attached to [illegible] which breaks the circuit and applies brakes at the same time. The weight of the whole machine will be about [illegible] pounds. The wheels that bear the car [illegible] made of steel without flanges, with [illegible] spokes and [illegible] bearings. Every part [illegible] constructed with the same view to lightness and

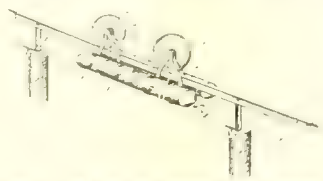


FIG. 1. ALLEN TRANSMITTING DEVICE.

strength. The cost of the road will be from $500 to $800 per mile, it is estimated. It is thought by the inventor that the car can be operated at a speed of two to two and one-half miles a minute, and carry a load from thirty to fifty pounds; and that two or more cars can be attached.

It may be necessary to extend the cable three or four feet below the track at one or more

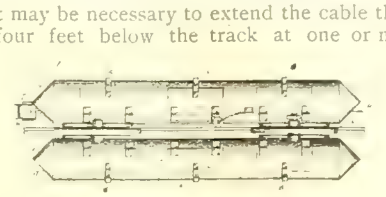


FIG. 2. ALLEN TRANSMITTING DEVICE.

points midway between the poles to make a truss support for the track, and if the poles are from thirty to fifty feet apart, the track can be made practically straight by this method. The track is so shaped that the car cannot leave it unless the frame work or the small wheels that run beneath and on the sides of the track are broken. Many arguments have been made against the

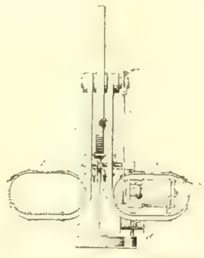


FIG. 3. ALLEN TRANSMITTING DEVICE.

practicability of a road for rapid transit of this kind, but with a single overhead rail and a light car carrying only a few pounds' weight, Mr. Allen maintains that the strength of material and other difficulties can be more easily overcome and a higher rate of speed attained than is possible with roads which are intended for the conveyance of weights of several hundred pounds.

New Electric Switch.

A new electric switch for street railway work has just been brought out by the Sprague Electric Railway & Motor company, which will simplify and make more compact than ever the method of controlling electric motors on street cars. The hand movement required to operate this switch is extremely limited, so that in case of emergency the motor can be stopped and reversed in an exceedingly short space of time, reducing all possibility of collision with another car, or with any possible obstruction on the track, to a minimum. The new switch is entirely fire and moisture proof, is only about half the size of the present railway switch, and is arranged so that it can be carried between the wheels, underneath the flooring, where it is entirely out of the way, and where it occupies no valuable room on the platform. The control is by a vertical rod, passing up from the switch-box to the platform, and looking exactly like a brake-rod. A movement forward of this handle for the space of a quarter of a circle means ahead at full speed, a reverse movement of the same amount means backing at full speed, and there are all the combinations between, so that it is possible to regulate the speed of the car to any degree desired. This improved switch does away with all through wiring in the car, all possible sparking inside of the switch. In case of any obstruction upon the track, the advantages of the improved switch over old methods of controlling the motors is evident. The natural tendency in case of an expected collision, is for the driver to jump back from his dashboard. By this movement he will carry his lever-handle with him, instantly reversing his machine without giving it a thought, and avoiding all trouble. This switch will be introduced upon all the Sprague electric railways which are now in course of construction.

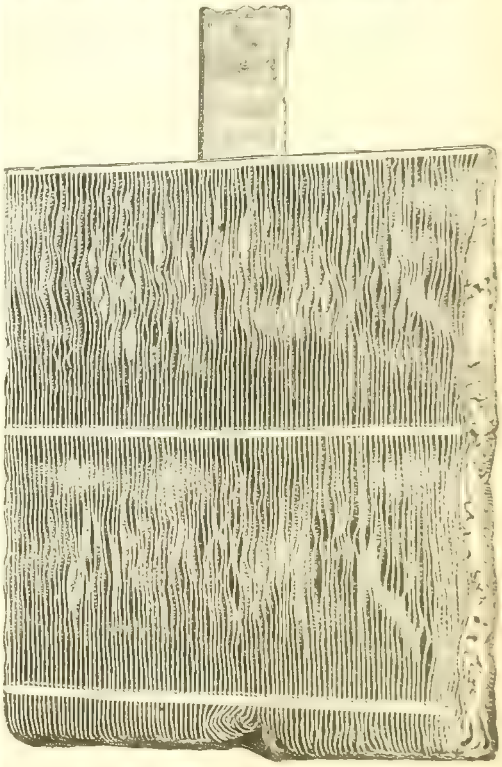
Annual Meeting of the American Institute of Electrical Engineers.

[illegible]

the members of the institute, from their [illegible] knowledge of the subject, as well as from papers [illegible] presented, that it is unnecessary for me to allude to [illegible] now four years since the Pennsylvania railroad, appreciating the advantages of electric lighting for this pur[illegible] began a series of experiments with the secondary battery, for the illumination of parlor cars.

I am [illegible] the cost of lighting [illegible] batteries referred to, as the expense appears to have been a secondary consideration compared with the necessity of securing the best system of illumination

The first experiments made by the company were [illegible] the Faure accumulator, which was brought to this country from [illegible]



SECONDARY BATTERIES IN TRAIN [illegible]

and put on passenger [illegible] No. 8[illegible] in August [illegible] year. The car was run for a few days only, but enough was learned in that time to show that the lighting [illegible] by secondary batteries was perfectly [illegible]

During the summer [illegible] experiments [illegible] storage batteries were commenced at the [illegible] the Pennsylvania railroad, and continued [illegible] and winter of that year. These experiments [illegible] by Dr. Dudley [illegible] cars which were [illegible] equipped [illegible] service on the 1st of April, 1885.

[illegible]

[illegible] was a very difficult [illegible] to the cell, you will understand, of course, that I allude more particularly to the positive plate. The weak points in the Brush battery were the small number of ampere-hours per pound of material—about two, I believe. There was a tendency to buckle and sulphate, and the arrangement for connecting the plates was such that there was oxidation at the junction, causing the plates to break when subject to the motion of the car. This last feature was a source of endless trouble to us, and as is usually the case, was sure to happen at a time or place where it was impossible to repair the break. While using the Brush battery the cars were wired with the battery boxes, one on each side of the car, coupled together in series, each box holding three trays, and each tray containing four cells, this giving a total of

Fig. 1.

twenty-four cells to a car, or a current of forty eight volts. The lamps used originally were of the Brush Swan type, with small platinum loops projecting from the base, these hooking into a socket and held in place by a spiral spring, this socket fitting into another one, to which the connections to the wires were made.

After using this style for some time an improved pattern of Brush-Swan lamp was substituted; but the great drawback to this lamp was its frailty, the breakage per day often averaging four per cent. of the total number of lamps in use on all the cars. These lamps required about forty-five volts and one ampere of current, and each car contained ten lamps, seven in the body, one in the smoking room and one in each vestibule, thus using about ten amperes of current; and as the batteries were rated at seventy ampere-hours, we should have obtained from six and one half to seven hours' good light, but it was very seldom, after the batteries had been used for a short time, that we could get over five and one half hours'. As will readily be seen, this could hardly be called economical, for to obtain five or six hours' light we were obliged to charge from fifteen to twenty hours with a Brush arc light dynamo giving a current of about ten amperes. Then taking the weight into consideration, each time the car needed charging, the trays, six in number and weighing 1,200 pounds, had to be loaded on the truck, pulled over to one side of the car, and the discharged trays taken out and the freshly charged ones put in their place. The remaining three were then taken around to the other side of the car and changed in the same manner. As the cars invariably stood on a double track, it was necessary to carry half the trays for some distance, over tracks, etc. Then again, the tracks were usually full of cars, and if there was not sufficient time for them to be parted the batteries had either to be carried under the car or over the platform. Under the present system this has been done away with to a great extent, as will be explained subsequently. During the month of December, 1886, we commenced using one battery of the 7 B type, manufactured by the Electrical Accumulator company. This battery was a decided improvement over those previously used, giving as it did nearly double the number of ampere-hours for the same weight of material. After using this battery for about a year the positive plates began to give way, and new ones were substituted, the negatives, however, being retained, as they had not deteriorated. In fact, we are still using the negative plates of our original 7 B battery. This battery proved to be so satisfactory that in June, 1887, we added two more of the same type and two manufactured by the Julien Electric company. The latter batteries were similar [illegible] shape to the 7 B type of the Accumulator company, but did not seem to stand the hard usage so well, as they would crack instead of buckling and allow a large quantity of the paste to become loosened and fall out. It is proper to state, however, that these plates were made [illegible] we were using, and were [illegible] This no doubt, will ac-

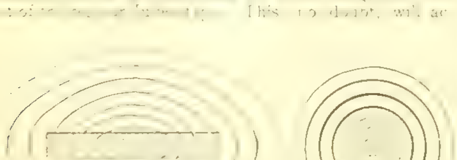


Fig. 2.

[illegible]

supply the current for the railroad telegraph as well as for lighting the passenger [illegible]

After the change in batteries had been made, it was thought best to change [illegible] system of wiring the car so that instead of its being necessary to put batteries on each side of the car, we need only put them on one side and get the same amount of light. This was done by connecting the two boxes in [illegible] in parallel and substituting 23-volt Edison lamps for our 45-volt Brush-Swan lamps. After doing this we found that we were able to get as many hours' light from twelve cells as we formerly did from twenty four. Of course this change reduced the expense of lighting the cars considerably, for where we formerly had a change of battery for each car or forty-eight cells, we now needed only twenty-four cells per car, with a few extra ones to be used in case the twelve cells would be unable to supply sufficient light for a long trip. This system of lighting proved so successful that it was decided to substitute it for gas in the remaining seven parlor cars. The wiring of these cars was commenced at the Meadow shops, near Jersey City, last September, and has just been completed. These cars are arranged for the 23 C type of the Accumulator company's battery and 19 B type of the Julien battery. The battery boxes under the cars are larger than the old style, and contain four trays or sixteen cells, the lamps we used taking twenty-three volts of current. Changes were also made the first of the year in the system of charging, and the batteries are now charged from an incandescent dynamo instead of an arc, thus enabling the batteries to be charged with any amount of current desired. In connection with this description of the four years' work of the Pennsylvania railroad, I would like to add something in regard to the electric lighting of the Chicago limited express.

In 1887 the Pullman Palace Car company commenced using the electric light on one of three trains of the New York and Chicago limited express, and the charging of the batteries at Jersey City was given into the hands of the Pennsylvania Railroad company. The batteries used were the 7 B type of the Electrical Accumulator company, thirty cells to a car, and usually there are six cars in the train. These batteries would furnish enough light for one trip, and each time the train arrived at either terminus it was necessary to replace them with freshly charged cells. This was not objectionable at Chicago, for the train arrived there in the morning, so that they could be charged during the day; but in Jersey City, where the train did not arrive

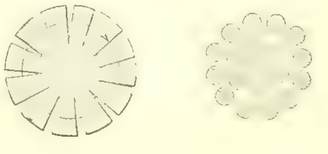


Fig. 3.

until evening, the work was very difficult on account of the dynamo being in use for other purposes. After this one train had been running a short time, another one was fitted up, 19 B type of Julien battery being used. It was thought that this would give us a chance to see which was the better of the two batteries, but they both worked very well, considering the treatment they received. After Mr. Bauer became connected with the Pullman company he did away with charging the batteries at the ends of the line, and introduced a Brotherhood engine and Eickemeyer dynamo in the baggage car of each train, in order that the batteries might be charged in transit. When the train leaves Jersey City the baggage car is on the rear, and consequently no charging is done until it leaves Philadelphia, where the train is reversed, bringing the baggage car next to the locomotive. The batteries are charged continuously until the train reaches Chicago, and the same practice is continued on the return trip. The steam for driving the Brotherhood engine is taken from the locomotive boiler, and the exhaust is used for heating the train

So far as the Pennsylvania railroad is concerned, the electric lighting of passenger trains may be considered an assured success, and leading as it does to the abolition of kerosene lamps, and incidentally encouraging the adoption of steam heating, the safety and comfort of the passengers are certainly increased.

Magnetism in its Relation to Induced Electromotive Force and Current.

BY ELIHU THOMSON.

There is perhaps no subject which at the present time can have a greater interest to the physicist, the electrician and the electrical engineer than the one which heads this paper. The advances which have been made in the study from its purely theoretical or scientific side, and the great technical progress in the utilization of the known facts and principles concerning magnetic inductions, can but deepen and strengthen that interest.

[illegible] and the eager collection [illegible] mitted to the scrutiny of the [illegible] mined and reasoned [illegible] satisfying ex- [illegible] of practice we find the earch [illegible] less diligent, though often [illegible] presented for solution. [illegible] often the greater on the [illegible] practice cannot, at least [illegible]

[illegible] triumphs in both directions, [illegible] be the framing of a theory [illegible] magnetic [illegible] experiment [illegible] region [illegible]

[illegible] magnetism and electric- [illegible] the ether of space

which medium has been theorized upon at great length, with the result of leaving it very much where it was before, a mysterious necessity

Faraday says, speaking of magnetism:

"Such an action may be a function of the ether, for it is not at all unlikely that if there be an ether it should have other uses than simply the conveyance of radiations." 3,075. Vol. III. Exp. Res.

"It may be a vibration of the hypothetical ether, or a state of tension of that ether equivalent to either a dynamic or a static condition, etc." 3,263. Vol. III., Exp. Res.

Faraday again says, speaking of the magnetic power of a vacuum:

"What that surrounding magnetic medium deprived of all material substances may be I cannot tell, perhaps the ether." 3,277. Vol. III., Exp. Res.

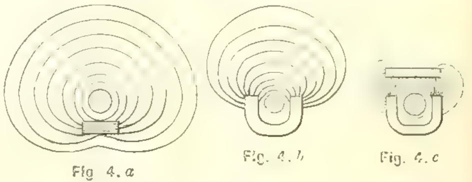


Fig. 4. a Fig. 4. b Fig. 4. c

Modern views would seem to point that through a study of magnetic phenomenon we may take a feeble hold upon the universal ether. Magnetism is an action or condition of that medium, and it may be that electrical actions are the expression of molecular disturbances brought about by ether strains or interferences. The close relations which are shown to exist between magnetism and light tend to strengthen such views. Indeed it would not be too much to expect that if the mechanics of the ether are ever worked out we should find the relation between sensible heat and electric currents to be as close as that of light to magnetism, perhaps find ultimately the forms of matter, the elements and compounds to be the more complex manifestations of the universal medium; aggregations in stable equilibrium. It is a difficult conception, I confess, and a most shadowy and imperfect one, yet facts and inferences which favor such views are not wanting.

Our science of electricity seems almost to be in the same condition that chemistry was before the work of Lavoisier had shed its light on chemical theory. Our store of facts is daily increasing, and apparently disconnected phenomena are being brought into harmonious relation. Perhaps the edifice of complete theory will not be more than begun in our time, perhaps the building process will be a very gradual one, but I cannot refrain from the conviction that the intelligence of man will, if it has time, continue its advance until such a structure exists.

I have been led to make these general allusions to electrical theory in order to emphasize the fact that in the present paper no unraveling of the mystery is to be attempted, but rather the presentation of some few considerations upon a subject of absorbing interest.

The conception of Faraday in regard to the existence of lines of magnetic force representing directions of magnetic strain or tension in a medium has not only lost nothing of its usefulness up to the present time, but has continually been of great service in the understanding of magnetic phenomena. We need spend no time in showing, as Faraday and others have done, that these lines are always closed circuits, polarized so that the direction of the lines cannot be reversed without reversal of the actions. Nor need we take time to show that in any medium the lines are mutually repellant laterally if of the same direction of polarization. Opposing this tendency to separation or lateral diffusion of magnetic force is the strong apparent tendency of the lines to shorten themselves in any medium. These actions are disturbed by the presentation of a better medium, as iron instead of space or air. Lines of force will move into the better medium, having apparently the constant tendency to diminish the resistance in their paths

The peculiar and mysterious nature of media such as iron is to permit an extraordinary crowding of lines on account of slight resistance to their passage through it. We need not, in addition, do more than refer to the other well-known facts of an electric current developing magnetic lines encircling the conductor, as being the general type, which includes all forms of magnetic field, or electro mag-

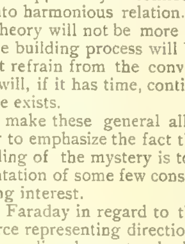


Fig. 5.

nets, sustained by currents, and the fact of a development when magnetic lines or circuits and material masses are in relative movement of electromotive forces transversely to the direction of the lines of magnetism and also transversely to the direction of relative movement, as in the case of electric conductors traversing or cutting through a field, or of a field traversing or being moved across a conductor. We must not forget that even insulators, as well as conductors, cutting lines of force, have the electromotive force developed in them. The action simply develops potential difference, and this generates the current where a circuit exists. While we are in the habit of saying that a conductor moved across a field of lines, or *vice versa*, generates electric current, I think the statement incomplete. The movement only sets up a potential difference and the power expended in effecting the movement generates [illegible] The current is energy less the potential, or the energy expended gives the two effects of potential or press-

ure, and current or rate of movement. Consequently an insulator, or an open-circuited conductor, traversing a field, consumes no energy, potential difference only being produced. Nevertheless, as will be shown, the magnetic circuits or lines themselves may furnish the energy for their own movement across a conductor, and so develop current as well as potential. This occurs in the effort of lines to shorten their paths, to lessen their density, to pass to better media. Indeed, a c'ose examination will show that wherever power is expended in developing current in a circuit, cutting lines of force, the energy expended is first employed in stretching the lines, which thus receive the energy required to permit them, in shortening, to cut the conductor and set up currents in the electric circuit in accordance with the potential difference developed in that circuit and its resistance.

I think we may also say, though I do not remember to have seen the statement so put, that whenever electric potential is set up inductively, as in self induction, mutual induction, induction from one circuit to another, and induction from magnets or magnetic field, it is set up by the movement of lines of force laterally across the body, mass

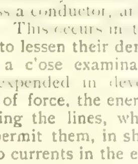


Fig. 6.

or conductor in which the potential is developed, and that whenever current is set up in a wire or an existing current prolonged, or an existing current checked by induction, self-induction, or induction from magnets, the action is a transfer of energy, represented by strained lines of force shortening or lessening their resistance, or lengthening and increasing the resistance in their paths. The magnetic field is like an elastic spring it can in one condition represent stored energy—it can be strained and will store energy—it can be made to relieve its strain and impart energy.

Let us examine some known phenomena in this light. Take the case of a simple wire conveying current say in a line away from observer. Fig. 1. There exists a free field of circular magnetism (so-called), shading off away from the wire and which is represented by concentric circles of increased diameter. The superior intensity or strength of the lines near the wire may also be represented by their thickness. This is often shown also by crowding the lines near the wire, though I am disposed to regard Fig. 1 as more nearly expressing the condition, unless we are to regard the lines as simply indicating a sort of atmosphere of magnetic effect whose density becomes less as we proceed outward from the wire, in which case either form of symbol suffices. The direction of polarization of the lines may be indicated by an arrow head pointing in a direction of right-handed rotation in the path of the lines. This is the typical figure or expression for all forms of simple magnetic circuit—the form of the lines, their length, position, density, will depend on the shape of the conductor or conductors (when more than one) and the materials surrounding or in proximity to the wire or wires.

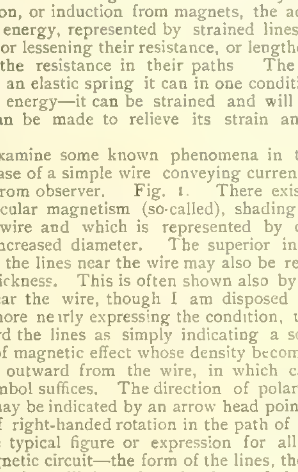


Fig. 7.

If the current traversing the conductor is constant the magnetic field around it is stable and static, unless other influences come in to modify it. The cutting off of the current is followed by instability of the field whereby it can and must produce dynamic effects. I say *must* because the field represents stored energy and in disappearing *must* give out that energy. To throw light on this part of the subject is one of the objects of the present paper. Cutting off the current supply in the case assumed leaves the developed magnetic lines or strains unsupported, they at once shorten their paths or circuits, collapsing upon the conductor as it were, and continuing this action, cut the section of the conductor, and apparently disappear in magnetic closed circuits of infinitesimal diameter but of great strength of polarization. It appears to me that we must either be prepared to give up the idea of lines of force or take the position that the magnetic circuits precipitate themselves in shortening their circuits and disappearing upon and cut the conductor. It was Hughes who put forward the idea that an iron bar in losing its apparent magnetism really short circuits the lines in itself as innumerable strongly magnetized closed circuits among the molecules. In becoming magnetic once more these short circuits are opened or extended into the air by some source of energy applied to strain the lines, such as a current in a conductor around the bar.

May not this idea be extended, then, to include the magnetic medium, the ether itself? Does it contain intensely polarized closed circuits of magnetism which are ready to [illegible], under certain conditions, [illegible] application [illegible] energy [illegible] by the col apse of the extended circuits? This is doubtless but a [illegible] of the real [illegible] of things [illegible] for a conception of [illegible] represented in thought [illegible]. There is one point [illegible]. The [illegible] energy in the ether, and [illegible] *must* [illegible] without giving out that energy. Ordinarily, it makes its appearance as the [illegible] current, [illegible] as to prolong the current [illegible] extended the [illegible] when an attempt is made to cut off the current. Were it conceivable that the current could be cut off and the [illegible] open circuit [illegible] remained open or strained, the energy must still escape when the field disappears. It would then produce such a high potential as to be able to discharge from the ends of the conductor, and if the conductor were of some section, part of the energy would be expended in setting up local currents in it The field could not disappear without an outlet for the energy it represents. But we cannot cut off a current in a wire so as to leave the wire on open circuit with the lines of the magnetic circuit remaining around it without iron or steel or the like in the magnetic circuit. We can approach that condition, however, by breaking the circuit very quickly with a condenser of limited capacity around the break. This is done in the Ruhmkorff coil primary; the condenser forms a sort of blind alley for the extra current on its beginning to flow out of the primary coil. But the condenser charges and backs up and stops the discharge from the primary, even giving a reverse current. The lines of magnetic force collapse, however, and have their effect in the enormous potential set up in the secondary coil.

Take away the secondary coil so as to stop that outlet, the energy expends itself on the iron core and the primary coil. Take away the iron core and the energy of magnetization of the air or ether core expends itself on the wire of the primary and, possibly, also on the dielectric of the condenser to some extent. The extra current becomes in this instance an oscillatory discharge of very high period back and forth through the primary coil from the condenser, until the energy is lost in the heat of $C^2 \times R$. This conversion is doubtless rendered all the more rapid by uneven distribution of current and eddy current set up in the wire of the coil.

The considerations just given concern the loss of field or the shortening and apparent disappearance of the magnetic lines or circuits, as giving rise to the self induction or increased potential on breaking. Where the energizing current is slowly cut off or diminished the energy is gradually transferred to the wire in producing elevation of potential during the decrease; and the collapse and cutting of the wire by the collapsing circuits or lines is then only more gradual

Let the current be returned to the wire after disappearance of magnetism and the lines again seem to emanate from the wire and at the same time cut it and produce a counter potential in it, which is the index of the abstraction of energy from the circuit, and its storing up in the form of elastically strained lines of magnetism around the conductor. The effect is that of self-induction on making or upon increase of current, the measure of the amount being the energy stored in the magnetic circuits which have been extended or opened up by the current. The greater the current and the shorter the path for the lines developed around the axis of the conductor the greater the energy stored up. Hence, a circular section conductor has the highest self-induction, a tube of the same section less as its diameter increases, a flat strip has less as its width increases and thickness diminishes, a divided conductor much less than a single conductor of same shape and section. Separating the strands of a divided conductor increases the length of magnetic paths around it and so diminishes the self induction. A striking instance of this latter fact was developed in conveying very heavy alternating currents of very low potential a distance of about three feet by copper conductors, the current being used in electric welding operations.

The conductors were built up of flat thin strips of copper for flexibility. When the strips were allowed to lie closely together the short conductor showed an enormous self-induction which cut down the effective potential at its ends near the work. By spreading apart the strips so as to lengthen a line around the conductor, the self-induction could be easily made less than 35 per cent. of what it has been before. The interweaving of the outgoing and return conductor strands as one compound conductor, gets rid almost entirely of the self-inductive effects, because neither conductor has any free space in which to develop strong magnetic forces, but is opposed in effect everywhere by the opposite current in its neighbor.

Where a number of conductors are parallel and have the same direction of current, as in a coil or in a strand, it is evident that statically the conductor may be considered as replaceable by a single conductor with the same external dimensions and same total current in the area occupied, the magnetic forces or lines surrounding them being of same intensity. But with changing current strength the distribution of current in the conductor has also a powerful effect on the energy absorbed or given out in accordance with the magnetism produced. Hence the self-induction of a strand, coil or conductor of the same section varies with the rapidity of current changes, owing to the conduction being uneven.

The uneven distribution of current, or its tendency to flow on the outer parts of a conductor when the rate of variation or alternation is made great, is in itself a consequence of the fact that less energy is transferred into magnetism in these cases, than when the current flows uniformly over the section or is concentrated at the center. In other words, when a uniform current traverses a conductor of the same section the circular magnetism or surrounding magnetic lines are to be found not only outside the conductor, but also beneath its exterior. Since in forming these lines

[illegible] This [illegible]

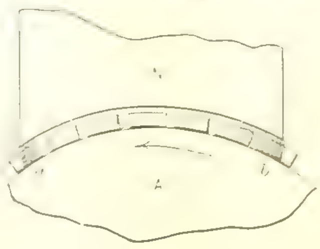


Fig. 8.

3. In this case the resistance of the interior magnetic circuits would be increased, as there would be several breaks in the continuity around the center of the conductor. The total magnetism which could be set up by a current would be lessened, and the self-induction, therefore, lessened.

The moment we begin the bringing of iron into proximity with an electric conductor conveying current, we provide a better medium for the flow or development of magnetic lines or circuits. In other words, the lines may then be longer, yet equally intense, or more lines may be crowded into a given section of this metal than in air or space. Figs. 4*a*, 4*b*, 4*c*, show the effect brought about by bringing iron of different forms near to the conductor.

It shows, in other words, the development of the ordinary electro-magnet of the horseshoe form, and the concentration of the lines in the better medium. The lines also tend to shorten and diminish the resistance to their passage, so that attraction of the iron to the conductor takes place, and if there is more than one piece of iron, they tend to string themselves around the conductor in magnetic contact with one another.

When copper bars of 1 inch diameter are traversed by currents of 40,000 to 60,000 amperes, as in welding them, the magnetic forces just referred to become so enormous that very heavy masses of iron brought up to the bar are firmly held, even though the current be of an alternating character, changing direction many times a second.

When a conductor is surrounded by a cast iron ring, as in Fig. 5, the current in such conductor has an excellent magnetic medium surrounding it. A large amount of energy is then abstracted on the first impulse of current, which goes to develop strong and dense magnetic lines through the iron ring and across the gap in it. On taking off the current the energy is returned as extra current, and

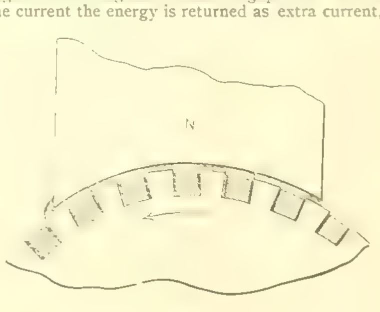


Fig. 9.

its force is many times what would be found with air alone surrounding the conductor. We have thereby [illegible] creased the self-induction, the storing of energy and opposition to current flow at the beginning, the giving back of energy and assistance to the current [illegible] to remove or stop the current. Let us now complete the ring by [illegible] Fig. [illegible] the [illegible]

We now find that [illegible] passing current through the conductor [illegible] meets with a very strong [illegible] [illegible] crowded iron ring, is impossible.

Now, let us cut off the current. We [illegible]

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THE last meeting of the American Institute of Electrical Engineers was a notable one. A number of able papers were presented, several of which appear in this issue. The balance will be published in the next number of the WESTERN [illegible].

AN interesting account of the work which is to be done for the lighting of the city of St. Louis, appears in the letter from that city in the correspondence column. It will be noticed that sev[illegible] of the municipal officers recently visited Chicago, and they speak in complimentary terms [illegible] in the city. Rest[illegible] rather chary in [illegible], but in this [illegible] at any rate, the official rose above local [illegible]dice.

[illegible] the [illegible] ation in that city. [illegible] 'The introduction of [illegible] lines in this city, is not only a great pub[illegible] to [illegible]rve indefinitely the homelike and attractive [illegible]tricts, which, [illegible] fully maintained under the pressure of fast in[illegible] of its inhabit[illegible] lawns and abundant [illegible], the gardens and roomy dwellings standing at a respectful distance from their neighbors, must be given up, or rapid transit in all directions must be provided. 'Flats' and blocks of narrow houses will always crowd in unless ample means are furnished for reaching the outlying districts, three, four and five miles from the center of the city, with the smallest possible loss of time."

A CORRESPONDENT cables the following concerning the electrical exhibit in the Paris exposition: That electricity constitutes an absorbing problem of mechanical invention and physical discovery, is shown by the prominent position its apparatus occupies. Throughout Machinery Hall and in various other parts of the exhibition there are 500 exhibitors in this branch. The universality of the study devoted to it is shown in the range of the countries represented by apparatus. These countries include France, Germany, Great Britain, America, Belgium, Switzerland, Algeria, Austria, Hungary, Chili, Denmark, Spain, Italy, Japan, Norway, Portugal, Russia and Finland.

PROF. BRACKETT concludes a popular article on "Electricity in the Service of Man," in the June *Scribner*, in the following words: It would be impossible to forecast the future, even for a single decade, with reference to the applications of electricity, even though the discovery were ended. The mere expansion of industries already in some degree established will give them an importance which we cannot now estimate. But the discovery is not ended, and it is more than probable that results not yet reached, which, although they cannot be at variance with the general doctrine of energy, as now understood, may to some extent revolutionize our methods with corresponding advantages.

THE residents of the North Side, Chicago, have thus far been unable to obtain incandescent lights, except in a few instances. Early in the spring permission was extended by the city council to the owner of a large apartment house in which an incandescent plant was located to lay underground near the curb line, a pipe containing cables leading to a house in the neighborhood, so that it too might be illuminated by current from the plant. The light was popular naturally enough, and wealthy residents in the vicinity sent to the council petitions asking for permission to connect their residences similarly with the plant. The requests were granted, but it has just been found that the petitions were more numerous than had been realized by the city. The work of putting in cables would involve tearing up several streets. Citizens objected, and now it is proposed to revoke the grants. The incident simply goes to show the demand which exists in residence districts for electric lights. Every effort now is made to secure the better illuminant, and the want must in some way be supplied.

IT is stated in a New York paper that it is now much more difficult to secure juries in capital cases than before the new law, providing for executions by the application of electricity, went into effect. It is a singular fact that this state of affairs should exist, as the new penalty was adopted because it was assumed that enlightened public opinion demanded the abolishment of hanging. A quotation from the article in question gives one explanation: "Unquestionably a strong prejudice exists among the generality of jurors against the infliction of death by electricity. It is not so much the fear that the new method is not sufficiently humane or the belief that the present method ought to be adhered to, as a grave, uncertain doubt which seems to fill the minds of many, that perhaps the use of electricity as a means of destroying life will not meet the expectations of those who have secured its substitution for the former method. A [illegible], which is not at all discredit[illegible] the average New York juror [illegible] to pass judgment on the fate [illegible] fearful his crime, and to [illegible] by incidents which [illegible] sympathy. New York juries impaneled in the criminal courts display a salutary reluctance to be the mere mechanical recorders of a verdict which a prosecuting officer may demand, or a presiding judge suggest. They seem to be filled, where the life of a human being is at stake, with a solemn sense of the responsibilities of the oath they have taken."

MILLIONAIRE HAGGIN, owner of the Anaconda mine, made an interesting statement while in Paris endeavoring to reach an agreemeut with the French capitalists. He said: "It costs me nothing to mine my copper," and "I can put it on the market in bars at an expense of less than three cents per pound." He added that the Calumet and Hecla copper was superior to his, but that could be put on the market for five cents per pound at the outside. "The Calumet and Hecla mine and my mine, the Anaconda, produce at the present time 60,000 tons annually, but neither of them works full capacity. If that concern and the Anaconda work full capacity, they can supply the world with nearly three-fourths of its annual consumption of copper." The owners of copper mines in America displayed their ingratitude, to put it mildly, when they entered this conspiracy with French capitalists, by which the American people were robbed of four or five cents per pound on all the copper consumed here.

A BILL of great interest to Illinois street car companies, and to corporations engaged in electric railway work, passed the Illinois legislature last Saturday. The measure referred to, the Dean-Wells bill, provides that any company operating a horse or dummy railway may change its motive power by the adoption of an electrical or cable system. Hereafter common councils will have nothing to say about the change of motive power. The substitution of one kind of service is to be done under the supervision of the proper municipal authorities, and the general character of the work must meet with their approval. It seems to be generally conceded that no cable lines will be built in Illinois outside of Chicago, so that the law will probably affect only those corporations which will substitute electric motors for existing systems. Companies will still be obliged, however, to obtain permissons from local authorities before they will be able to erect overhead circuits, as the law states the company which desires a change may make all needful and convenient trenches, excavations, and sewer connections in such streets or alleys, and may place all needful and convenient cables and machinery on any streets or alleys upon which its railways have been or shall be authorized to be constructed; provided, however, that such cables and machinery shall be underground, and constructed in a substantial and workmanlike manner, of most approved method and convenience, so as not to interfere with public travel, and the aperture opening, if any, into said trenches shall not exceed five-eighths of an inch in width. The advocates of the bill give these arguments in favor of the measure: It enables the companies to use the latest and best improvements in street car locomotive power without waiting upon a city council, the members of which may be influenced and controlled by local interests and prejudice, instead of looking at the interests of the great traveling public. They consider that the highest legislative power in the state has a right to legislate upon this question, and should not delegate the power to others. They regard the use of improved motive power for street cars in cities one of the vital questions of the hour. The suburbs must be brought nearer the heart of the city, in time of transit, and any legislation that will encourage the companies to solve this question speedily is to the interest of the public. The bill in effect shows that the legislature considers that animal power should be discarded, and at the same time it stamps with approval the electric railway system. As a practical measure the bill may not be of great importance, as usually throughout Illinois city councillors are intelligent enough to see the great benefits to be derived from the substitution of an electric system for horse car service, and as a consequence they are as a rule not disinclined to give their permission for a change.

(Continued from page [illegible].)

prised to find a very weak [illegible] current, a practical absence of self induction on breaking, or at least a giving out of energy in [illegible] compa[illegible]rable to that on making. Let us put on the current [illegible] was before. Another curious result. But little self induction now on making, energy not absorbed.

Now cut off the current again. Same effect as before. Now let us put on the current reversed in direction. At once we find a very strong counter potential or opposing self induction developed.

The ring had been polarized, or retained its magnetic energy, and we are now taking out one set of lines and putting in reversely polarized lines of force. This done, we break the reversed current without much effect of self-induction. The ring remains polarized and inert until an opposite flow of current be sent through. Iron is then a different medium from the ether.

The ring once magnetized must in losing its magnetism permit a closing of the lines by shortening. This involves their passage from the iron across the space in the center of the ring, notwithstanding its great resistance to the lines of force. As passage from iron to air is equivalent to lengthening of the lines it is readily seen that such lengthening may oppose more effect than a slight shortening due to leaving iron, for air or space may give in provoking a closure and disappearance of the lines. Looked at from another standpoint, the lines on the iron may actually require a small amount of initial energy to dislodge them therefrom, so that after being dislodged they may collapse and yield whatever energy they represent.

I must reserve for the future further consideration of the iron ring, but in thinking upon this matter I am led to think that the production of a magnetic line in an iron ring around a conductor may represent a sort of wave of energy, an absorption of energy on the evolution of the line from the conductor and a slight giving out of energy on the line reaching that position of proximity to the iron ring that its passage thereto may be said to be a shortening process or a lessening of its resistance.

The magnetism in air, gases and non-magnetic bodies, being assumed to be that of the ether, this medium shows no such effects as those we get with the ring. It does not become permanently polarized, as does even soft iron under the condition of a closed ring. The iron possesses coercive force, or magnetic rigidity, and a steel ring would show more of it. The molecules of the iron or steel take a set. If we were to cut the soft iron ring or separate it in any way, this introduction of resistance of air for ether in the magnetic circuit would cause the lines to collapse and set up a current in the conductor. The energy of the ring would have been restored to the latter. The curious thing is that physically the polarized ring does not present any different appearance or ordinary properties different from those of a plain ring, and will not deflect a compass needle. Its condition is discoverable, however, by the test of self-induction to currents of different direction. As a practical consideration, we may mention in this connection that a self inductive coil for currents of one direction must be constructed differently from one to be used with alternating currents. The former must have in its magnetic circuit a section of air or the like, or be an imperfectly-closed circuit, as it were. The latter should have as perfectly closed a magnetic circuit as can be made. We see here also the futility of constructing a Ruhmkorff core coil on the closed iron magnetic circuit plan, because the currents in the primary are interrupted, not reversed.

The considerations just put forward in relation to the closed iron ring, and its passive character under the condition of becoming polarized, are more important than at first appears. It has been found that the secondary current wave of a closed iron circuit induction coil or transformer, whose primary circuit receives alternating currents, is lagged from its theoretical position of 90 degrees behind the primary wave an additional 90 degrees, so that the phases of the two currents are directly opposed; or the secondary current, working lamps only in its circuit, is one-half a wave length behind the primary, instead of only a quarter wave length, as might have been expected.

But when it is understood that the iron core polarized in one direction by the primary impulse does not begin to lose its magnetism when that impulse simply weakens, but waits until an actual reverse of current has taken place, it will be seen that the secondary current, which can only be produced when magnetic lines are leaving the core and cutting the secondary coil, or when the lines are being evolved and passing into the core from the primary coil, will have a beginning at the moment the primary reverses, will continue during the flow of that impulse, and will end at substantially the same time with the primary impulse, provided the work of the secondary current is not expended in overcoming self-induction, which would introduce a further lag. Moreover the direction of the secondary current will be opposite to that of the primary, because the magnetic circuits which are opened up by the primary current in magnetizing the core, or which are closed or collapsed by it in demagnetizing the core, will always cut the secondary coil in the direction proper for this result. Transformers of the straight core type with very soft iron in the cores and not too high rates of alternation should approximate more nearly the theoretical relation of primary and secondary waves, because the magnetic changes in the core are capable of taking place almost simultaneously with the changes of strength of the primary current. This fact also has other important practical and theoretical bearings.

Let us assume a plain iron core, Fig. 7, magnetized as indicated, so that its poles *N S* complete their magnetic circuits by what is called free field or lines in space around it. Let a coil of wire be wound thereon as indicated. Now assume that the magnetism is to be lost or cease; either suddenly or slowly. An electric potential will be set up in the coil, and if it has a circuit, work or energy will be produced or given out in that circuit, and in any other inductively related to it. Hence the magnetic field represents work or potential energy. But to develop potential in the [illegible] lines [illegible] the [illegible] [illegible] molecular magnetic circuits interior to the iron medium. [illegible] may [illegible] through the [illegible] tended, the field disappears, and the lines moving [illegible] ward [illegible] across the coil opposite to the former [illegible] tion, and produce a counter potential in the wire, and consequent absorption of the energy represented [illegible] field produced. As before studied, the magnetism cannot disappear without giving out the energy it represents, even though the wire coil be on open circuit, and therefore unable to discharge that energy. The coil open circuited is static, not dynamic. In such assumed case the lines in closing cut the core and heat it. Let us, however, laminate the core or subdivide it as far as possible, and we appear to have cut off [illegible] escape for the energy. This is not really so, however. We have simply increased the possible rate of speed of closure, or movement of the lines, and so have increased for the divided core the intensity of the actions of magnetic friction and local currents in the core, the latter still receiving the energy of the magnetic circuit. This reasoning is based on the possibility in this case of cutting off the current in the magnetizing coil and retaining the magnetic field. This is of itself probably impossible with soft iron. That the core receives the energy when the coil cannot is shown in the well-known fact that in some dynamos with armatures of bobbins on iron cores, the running of the armature coils on open circuit gives rise to dangerous heating of the cores, and that under normal work the heating is less. In the former case the core accumulates the energy represented in the magnetic changes. In the latter the external circuit of the machine and its wire coils take the larger part of the energy which is expended in doing the work in the circuit. In this case, also, the current in the coils causes a retardation of the speed of change and extent of change of magnetism in the iron cores, which keeps down the intensity of the magnetic reaction. In fact, this retardation or lag and reduction of range of magnetic change may in some machines be made so great by closing the circuit of the armature coils themselves or short circuiting them that the total heat developed in the cores is much less than under normal load.

I wish now, in closing, to refer briefly to phenomena of moving lines of force, and to the effects of speed of movement. In order to generate a given potential in a length of conductor we have choice of certain conditions. We can vary the strength of field and we can vary the velocity. We can use a strong field and slow movement of conductor, or we can use a weak field and rapid movement of the conductor. But we find also that where the conductor has large section it is liable to heat from eddy currents caused by one part of its section being in a stronger field than another at the same time. One part cuts the lines where they are dense and the other where they are not dense, with the result of difference of potential and local currents which waste energy in heat. We cannot make the conductor move in a field of uniform density, because it must pass into and out of the field. The conditions just stated are present in dynamos for heavy current work, where the speed of cutting of lines is low and the armature conductor large in section.

But we find that in a transformer secondary we can use very large section of conductor, even (as in welding machines) 12 to 15 square inches solid copper, without meeting appreciable difficulty from eddy currents in it. The magnetic lines certainly cut the heavy conductor and generate the heavy current and potential needed. What difference, if any, exists? In the transformer the currents are generated by magnetic field of very low density, in which the lines are moving across the conductor with extreme rapidity. The velocity of emanation of lines around the primary coil is probably near that of light, and each line passes across the section secondary conductor in a practically inappreciable time. There is no cause then for differences of potential at different parts of the section heavy secondary. Then to avoid eddy currents in large conductors and generate useful currents in them, we may cause the conductor to be either moved into and out of a low density field with very great speed, or better, we must cause the lines of a very low or diffused field to traverse or cut across the conductor with very high velocity.

It is a known fact that in dynamos with large section armature conductors there are less eddy currents produced in the conductors when they are provided with iron cores or wound upon iron cores, then when the conductors are made into flat bobbins moved in front of field poles. Projections existing on the armature between which the conductors are placed have a like effect, and enable us to employ heavy bars or bundles of wire without much difficulty from local currents. The reason is simple. In the armatures with coils without iron in them or without projections extending between the turns the conductor moves into and out of a very dense field at comparatively low velocity, so that any differences of potential developed in the parts of the section of conductor have full effect and abundant time to act in setting up harmful local currents. In the cases in which iron projects through the coil or conductor the real action is that the lines of the magnetic circuits move at high speeds across the conductor, and the conductor is at all times in a field of very low density. Figs. 8 and 9 will make this plain. In Fig. 8 we have shown a smooth armature surface having a heavy conductor laid thereon, and which is at *a*, just entering a dense field at the edge of the pole *N* and at *b* leaving such field. It will be seen that when in such position the conductor, if wide, is subjected to varying field strength, and moves at a low speed for the generation of the working potential as it passes through the field, thus giving rise to eddy currents in the conductor.

In Fig. 9 the conductors are set down between projections, in which case both armature and field poles are laminated or subdivided. As each projection leaves the edge [illegible]

[illegible]

[illegible] cuit transformers and closed iron circuit (projection [illegible]) mos, as we may call them.

I had intended at the outset of this paper to deal to some extent with the propagation of lines of magnetism undergoing retardation, [illegible] reference to alternating current [illegible] devices, transformers with limited secondary current, or constant average current, an alternating motor working with what I may term a translation lag, etc., but it was soon found that these matters must remain over for a continuation of this paper at some future time. My endeavor has been in the present paper to deal with the lines of force theory as though it were a symbol of the reality, but I confess that it is done with many misgivings that I may have carried it too far. Yet if we are to use the idea at all, it has seemed but right to apply it wherever it may throw any light on the subject or assist in our understanding of phenomena.

The Spiral Voltameter.

BY HARRIS J. RYAN.

During the present year at the physical laboratory of Cornell University, the copper voltameter has been used somewhat extensively in laboratory practice by students for calibrating Thomson graded galvanometers, tangent galvanometers, and other electrical measuring instruments where a single determination suffices as a calibration. For practical instruction students are made to check their results on a Thomson gravity balance, and by means of the large galvanometer at the Magnetic Observatory.

The plate form of copper voltameter has been thoroughly and admirably investigated by Thomas Gray,[1] of the Physical Laboratory of the University of Glasgow. We are indebted to Mr. A. W. Meickle and to Lieutenant Anderson[3] for clear descriptions, based upon the results of Mr. Gray for the use of this form of voltameter, whereby determinations may be made so accordant that one can scarcely think of more to be desired.

With all this, however, it has been our experience that students are slow to obtain accordant results when making their first attempts to follow Mr. Gray's methods. It seemed desirable to make use of a form of voltameter that required the least consistent time and care to construct and prepare for operation. Again, there should be a wide allowable range of current density, through which deposits would be as firm and adherent as possible. It was with a view of realizing this that we finally adopted and made use of the spiral coil form herein described.

A wire coil as a cathode seemed to present many advantages. Wire of high conductivity, good for this purpose, is generally available in any desired size. A wire can be cleaned properly with great ease and readiness by fastening one end in a vise, holding the free part in one hand and sandpapering it with the other. By beginning at the vise to clean it is not necessary to touch the cleaned wire with the hands throughout the complete operation of [illegible] and coiling into a spiral on a cylinder of the proper diameter, about which has been rolled clean paper. In this manner gain and loss coils are constructed.

Figs. 1 and 2 show the final form of voltameter [illegible]. The coils are hung vertical. The cathode is made [illegible] diameter and is arranged inside and [illegible] with the anode. The diameter of the anode is [illegible] cm. to 4 cm. larger than that of the cathode. [illegible] prepared as above are ready for use [illegible] reasons their changes of weight are [illegible] surface of the gain coil must not be touched [illegible]. It is easy to handle it by the extending [illegible] of which it is suspended in the voltameter. After [illegible] it is washed by plunging [illegible] a little H_2SO_4.

It is then rolled in [illegible] blotting paper [illegible] but a mere film of the water. [illegible] per cent [illegible] lowed to [illegible] the same [illegible] on clean filter or blotting paper [illegible] film [illegible] in a few moments [illegible]

Coils that have been [illegible] be [illegible] known [illegible] ing them [illegible] strong HNO_3 [illegible] hundred parts [illegible]

[illegible]

them quickly to a distance, such that the vapors of the acid [illegible] of the preparation. [illegible] in water, and then [illegible] plunging in the acidu- [illegible] weighing, the coils are [illegible]

[illegible] a coil made of two [illegible] having the surface [illegible]

[illegible] number of these are ar- [illegible]

[illegible] necessary. At the end of the deposit the gain coils are immediately removed, [illegible] and then into the acidulated, from which they are dried by means of alcohol in the manner above described. When dried they are at once ready to weigh.

The copper sulphate, water and acid, need not necessarily be chemically pure. The density of the voltameter solution should be not less than 1.10 and not more than 1.18.

The question now comes to us as to what degree of accuracy and precision of results we may depend upon from the above form of voltameter.

The successful use of the copper voltameter has come from an appreciation and an understanding of the fact that when copper is immersed in an acidulated solution it passes slowly into solution in an irregular way. Mr. Gray has done much work in this particular, and has shown that the going into solution of copper on the cathode is curiously assisted by the current. From the extensive work done with the plate form of voltameter at Glasgow results have been gained with regard to the amount of copper that goes into solution for a certain current density and a certain temperature, that it is a comparatively easy thing to make determinations with assured absolute accuracy to within a tenth or even a twentieth of one per cent. This is remarkable, though nevertheless true.

A Thomson deca-ampere balance was calibrated by means of the copper voltameter under Mr. Gray's directions at Glasgow.

When the same was received and set up at Ithaca in the physical laboratory of the University, it was compared with the large standard tangent galvanometer at the Magnetic Observatory, and found to agree with the same to within one-tenth per cent.

Surely this same or even a greater degree of absolute accuracy could be obtained with less trouble and experience by one making use of the spiral coil cathodes. Mr. Gray has shown that if copper went into solution, unaided by the current, we could in almost all cases neglect this correction. He has shown us how much it is when a plate is used as a cathode. There are strong reasons, however, for believing that when a wire, which presents a regularly curved surface, is used as a cathode, that the copper from it goes into solution in a more regular way, and that probably in all cases to a considerably less degree. Again, by the use of the spiral coil in a voltameter we find an advantage in the fact that the plane of each turn of wire is disposed horizontally, so that by convexion the solution is not allowed to become weak near the cathode, nor dense near the anode.

This fact was first pointed out by Mr. Shaw, who speaks of the very accordant manner in which platinum wires disposed horizontally are found to act as cathodes in copper electrolysis.

In a valuable paper by Mr. Shaw on "The Verification of

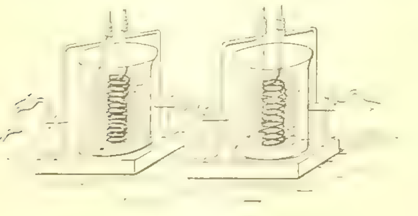

Fig. 1.

Faraday's Law of Electrolysis with Reference to Silver and Copper," the very great range of current densities for the [illegible] centimeters to 800 centimeters per ampere has been brought to bear on [illegible] when the currents are [illegible] the writer has [illegible] current density to [illegible] Cavendish [illegible]

[illegible] below the rest, [illegible]

3.101 [illegible] found. [illegible]

Finally the writer has found that if we take the values for the chemical equivalents for silver and copper as quoted by Wurtz and [illegible] Meyer that the calculated values for [illegible] 3.399 to 3.401.

Therefore since we know with great assurance the value of the electro-chemical equivalent of silver, we have an equal assurance that with a current density of one ampere for every 50 square centimetres exposed the amount of copper deposited will be .0003287 grammes per coulomb.

Again, we see that in a range of current density from 50 centimetres to 300 centimeters per ampere this line indicates a change in the amount of copper deposited from .0003287 to .0003270. It is to be remembered that these results were obtained by the use of a solution almost saturated and without acid. Returning to Mr Gray's work we find that for the same range of current density the amount of copper deposit changes from .0003287 to .0003272 for a temperature at which Mr. Shaw probably worked.

It is well known that the copper goes into solution under the action of the current from the cathode at a much greater rate without acid than with, and especially at a greater rate when the solution is dense than when working under the proper conditions for measuring current. A comparison of Mr. Gray's and Mr. Shaw's results brought us to the belief that less copper should be dissolved from cathodes of the spiral coil form than those of the plate form.

To determine this four cells were arranged by Mr. Gun-

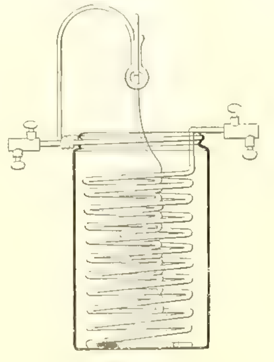

Fig. 2.

ning a student in the Sciences at Cornell. Two of these had cathodes and anodes of the plate form, and the other two those of the "spiral coil" form. The large plate and coil and the small plate and coil had areas of 100 centimetres and 10 centimetres respectively. About half an ampere was passed through them for a time, amounting to two and one half hours.

Every half-hour they were taken out, dried and weighed, the solutions all intermixed, and the deposits continued for another half-hour, etc.

The solution has a density 1.1, and an addition of 1/4 per cent acid. An examination of the intermediate results gives the same result that one gets by looking at the total gain of the coils and plates taken separately. Mr. Gunning's results were as follows:

Temperature, 20 degrees.

Coils: Small	Coils: Large.	Plates: Small	Plates: Large
100 c m	1000 c m	10 c m	1000 c m
[illegible]	[illegible]	1.51 [illegible]	[illegible]

The result shows that in going from a density of 20 centimetres to 200 centimetres per ampere, the amount of copper per coulomb changed from .0003289 to .0003283 for the coils, and for the plates .0003285 to .0003275.

The result with the plates does not differ materially from that found by Mr. Gray for a similar range.

Mr. Gunning also made a number of comparisons of the spiral coil voltameter at different current densities, and at a mean temperature of 23 degrees centigrade, with the standard tangent galvanometer at the Magnetic Observatory. These were made with great care in every particular but one, and that was in the matter of time. This was taken from his own watch, that had not been compared with our standard chronometer. Again, to make and break the circuit, a large switch capable of carrying 250 amperes was operated, which added incidental errors, since the duration of each deposit was only 1,800 seconds; the results are interesting, because of their accordance and the manner in which they were obtained, and are given in the following table:

D[illegible]	C[illegible]	Coil No. 1	Coil No. 2	[illegible] per hour.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	.177
" "	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] the laboratory, [illegible] to the former [illegible] correct time [illegible] otherwise [illegible] that Mr. Gunning [illegible] the following [illegible]

[illegible]

[illegible] grammes per ampere per hour [illegible]

is computed to be 1.182. And we know that for the above current density it should be 1.183. The galvanometer at the observatory is subject to a fluctuation in its indications by an amount that almost covers the above, due to variations of horizontal intensity throughout the succession of day and night.

The writer and E. G. Merritt, Fellow in Physics, Cornell University, hope to make a thorough investigation of the "Spiral Coil Voltameter" in its use with silver and copper shortly.

From the ease with which those inexperienced in the use of the copper voltameter obtain consistent results, it was thought well to recommend its use in the meantime to others.

The Efficiency of the Arc Lamp.

BY HATSUNE NAKANO.

Preliminary Note.

The interesting results recently obtained by Mr. Merritt in the application of the method of Melloni to the investigation of the efficiency of the incandescent lamp have made it seem desirable to extend that method to the study of the arc lamp also.

Existing data concerning the efficiency of this source of light are exceedingly imperfect, being based chiefly upon measurements with the Bunsen photometer. Ordinary photometric determinations of the light giving value of sources of illumination differing widely in temperature from the standard candle, are necessarily at fault; and I have endeavored in a recent paper[1] to call attention anew to the character of the errors involved in the comparison of the light of the electric arc with that of other sources of artificial illumination.

The efficiency of the arc lamp has been expressed hitherto in terms of the candle power of light produced per unit of energy expended. The estimate has been based in a few instances upon the mean spherical candle-power, as actually determined; more frequently upon the candle-power emanating from the lamp in a single, especially selected direction, and in too many instances upon the "nominal candle power." Such estimates of the efficiency of the arc are of small value. They afford us widely varying results which cannot be definitely compared, and even when they are based upon the most complete and careful determinations of candle-power and energy, they do not indicate the ratio of light-giving radiation to the total energy expended within the lamp. It seemed, therefore, to be of some importance to obtain measurements of the ratio of luminous to total radiation in the case of the arc lamp by a method the results of which would be directly comparable with those already obtained for the incandescent lamp.

The investigation was undertaken, at my suggestion, by Mr Hatsune Nakano, M. E., of the Imperial University

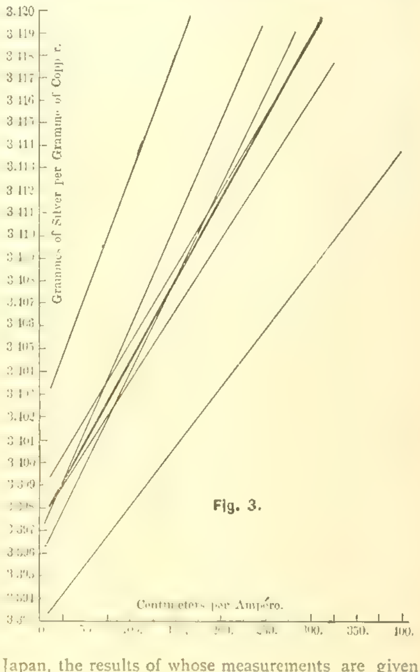

Fig. 3.

of Japan, the results of whose measurements are given in the following pages. E. L. Nichols.

The Efficiency of the Arc Lamp.

The following experiments were made in the Physical Laboratory of Cornell University during the winter of [illegible], the object in view being to determine the efficiency of the arc lamp.

It is a well known fact that the comparison of the candle power of differently colored lights, such as the candle and the electric arc, is only a rough approximation. By means of one of the methods recently described by Mr. Merritt,[2] however, we can determine the efficiency of the arc independently of its candle power. The method in question enables us to find the ratio of the light giving radiation to that of the total radiation of the lamp.

In his first experiments Mr. Merritt measured the heat given out by a lamp which was immersed in the water contained in a calorimeter. It is evident that this method, though very ingenious, cannot be employed conveniently in

[1] The Efficiency of Methods of Artificial Illumination. Transactions of the American Institute of Electrical Engineers, Vol. 6.

[2] Ernest Merritt, Some Determinations of the Energy of the Light from Incandescent Lamps. The American Journal of Science, Vol. 37, p. [illegible].

the case of the arc lamp His second method is, however applicable to arc lamps as well as to incandescent lamps. This method and the arrangement of the apparatus were fully described by Mr Merritt in his paper [illegible] American Association for the Advancement of Science at their meeting in Cleveland. It was also described by Prof. Nichols in his paper read before the American Institute of Electrical Engineers, March 12, 1889.

The application of the method to the arc lamp was as follows The rays of the lamp were allowed to fall upon

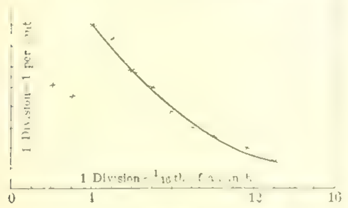

Fig. .

the face of a delicate thermopile which was in circuit with a sensitive galvanometer. The deflection of the galvanometer was taken as a measure of the energy of the total radiation which fell upon the face of the pile.[3] After the deflection due to the total radiation had been measured, a glass vessel of rectangular shape one decimeter thick, containing a strong solution of alum, was placed between the lamp and the thermopile, and the reduced deflection of the galvanometer observed. The use of the alum cell was to cut off the "dark heat," and allow only the rays of the visible spectrum to reach the face of the thermopile. But a certain small percentage of the longer wave-lengths passed through, and a considerably larger percentage of luminous rays were cut off by the cell. To determine the correction for the former source of error, a cell containing an opaque solution of metallic iodine in bisulphide of carbon was

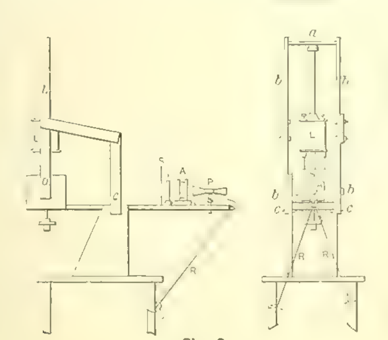

Fig. 2.

placed between the lamp and the alum cell. Any deflection now obtained was due to the dark rays passing through the alum cell, for the iodine cut off the luminous rays entirely, but allowed the dark rays to pass through. It was found that the dark rays which passed through the alum cell were exceedingly weak—almost imperceptible in most cases.

The correction for the second source of error, viz., the absorption of the luminous rays by the alum cell, was determined photometrically. The average of some thirty measurements gave 26 per cent. for the value of the correction.

In my first measurements, the lamp (the center of the arc) and the thermopile were placed in the same horizontal

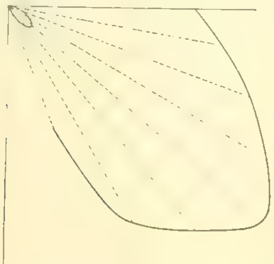

Fig. 3.

plane. The lamp used was a "rack feed" arc lamp requiring 45 volts and 9 amperes for its normal operation. Experiments were made with a dozen or more of different sizes of carbons, ranging from 2-16 up to about 13-16 inch in diameter.

The efficiency or the ratio of the energy of the luminous radiation to that of the total radiation, luminous and non-luminous, [illegible] was found to be [illegible] fell off again

[illegible] of these measurements [illegible] first column the diameters of the carbons [illegible] the second column [illegible] horizontal efficiency;' that is to say, the ratio of the deflection produced by the total radiation of the lamp [illegible] to the light-giving radiation alone, after the proper corrections for absorption and diathermancy have been applied. Each value is the mean of a series of observations. The third column gives the potential difference between the terminals of the lamp.

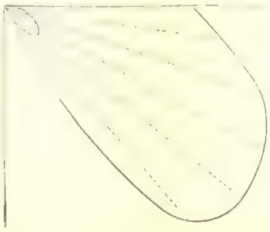

Fig. 4.

TABLE I.

Diameter of Carbons. (In inches.)	Horizontal efficiency.	P. D. (Volts.)
.832	.01484	42
.730	.02162	45
.605	.02527	43
.563	.03125	38
.500	.03793	37
.432	.05014	35
.370	.05861	28
.305	.07338	31
.250	.0513	56
.185	.0458	25
.124	.0514	30

The curve *CD*, given in Fig 1, shows the relation between the efficiency, measured in the horizontal plane, and the diameters of the carbons. The ordinates represent efficiencies, and abscissæ the diameters. It will be noticed that the points *A* and *B*, corresponding to 2-16 and 3-16 inch carbons, are far below the curve, showing that the relation is modified as soon as the carbons become too small to carry the current without heating.

In the electric arc, as Prof. Nichols has shown in the paper already referred to, "The entire light-giving area is included between the line surrounding the positive carbon, which is at red heat, and the corresponding line upon the negative carbon. Now the surface of total radiation is much larger than that from which the light giving rays emanate. It includes in addition to the incandescent surfaces near the arc, all those portions of the carbons which are heated, either by conduction or by the current. Were the distribution of total radiation in the vertical plane identical with that of the light-giving rays, the measurement of their ratio with the axis of the thermopile in any plane which passes through the arc would give us the efficiency of the lamp, but the curve of distribution of total intensity

Fig. 5.

is not the same as that of candle-power, and the ratio in question is a function of the angle which the axis of the pile makes with the horizon It becomes necessary, therefore, to make an exploration of the entire zone through which the lamp sends out rays, determining the ratio of luminous to total radiation for each angle and then to integrate the results."

With such an object in view the piece of apparatus which is shown in Fig. 2 was devised. The lamp was hung from a horizontal beam (*a*), supported by two upright pieces (*bb*) which could be kept always vertical by means of a "parallel motion" arrangement The alum bath [illegible] and the thermopile [illegible] were also carried upon a board pivoted at [illegible], so that it could be turned to any desired angle All necessary changes of angle could be made without alter ing the direct settings, I continued to use my eyes independently, viewing the image of one side of the disc with the right eye, the other with the left There resulted a set of readings, such as I had expected to obtain from all the observers, the mean of which lay as far from the center of the photometer bar as the mean of the direct readings, but upon the other side. Compare sets "B," Tables 2 and 3.

The results obtained with the mirror are given in the following table:

[illegible]

Fig. 6.

The [illegible] mirror [illegible] sets of direct readings made with one eye bandaged. It was found that although more fatiguing, these monocular settings [illegible] of the observer which had not accompanied the settings made with both eyes. In the latter case, indeed, a conflict between tendencies to set the disc in two distinct positions had been very apparent, the observer unconsciously [illegible] The set of readings given in full in table 4 [illegible]

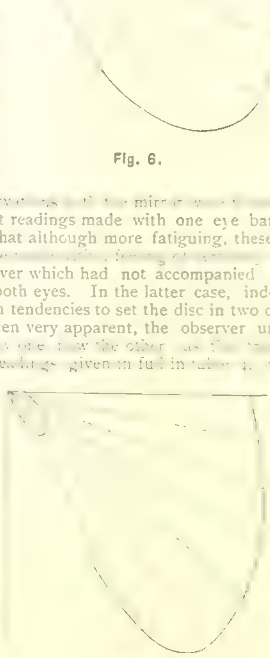

Fig. 7.

illustrate the result of this tendency. The instances in which the observer seems [illegible] in his judgment of the true setting, are printed in heavy type.

TABLE 4.

[illegible]	[illegible]	[illegible]	1.048
[illegible]	[illegible]	[illegible]	1.053
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	1.050	[illegible]	[illegible]

This tendency to vacillation disappeared almost entirely when only one eye was used. The readings obtained with

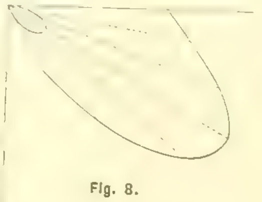

Fig. 8.

a single eye not only [illegible] much [illegible] themselves than those made under like [illegible] eyes, but the result obtained with the left eye were i[illegible] cal with those obtained with the right [illegible] error that had [illegible] usual way

[illegible] complete agreement

[illegible] less than the [illegible] of each set

[3] John Ericsson in his "Contributions to the Centennial Exhibition," 1876, says that the calorific energy imparted to a thermopile is not proportional to the arcs through which the needle of the galvanometer sweeps, as stated by Melloni, but that for deflections not exceeding 15 degrees, the calorific energy imparted to the pile by radiant heat is very nearly as the square root of the versed sine of the angle of deflection; the deflection of the needle at the termination of the first degree exceeding the energy transmitted, in the ratio of [illegible] to 82, and beyond 90 minutes the energy becoming greater than the deflection in a constantly increasing rate. Ericsson does not state, however, what kind of galvanometer he used in his investigations. The one used by me was a low resistance reflecting galvanometer of Sir William Thomson's pattern. It had been tested by Mr Merritt, who found that the deflections were proportional to the energy imparted to the pile. In my experiments this proportionality was assumed to be true

		Ratio	Personal error.
[illegible]	[illegible]	[illegible]	.0004
I. M.	[illegible]	[illegible]	[illegible]31
E. N.	[illegible]	[illegible]	.0031
F. N.	I[illegible]	[illegible]	0.001

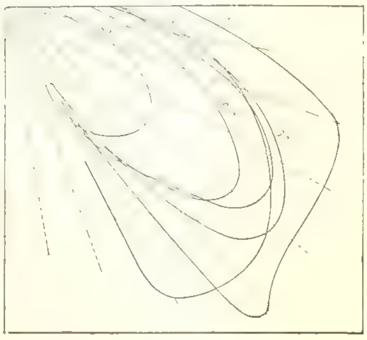

Fig. 9.

It had been my intention to extend the experiments described in this paper to a much larger number of observers.

The evidence obtained, however, seemed quite sufficient to establish the existence of the personal error in photometry, and to show that it was in general very far from being a negligible quantity. Frequent repetitions showed, that in my own case at least, the error was very nearly constant, and I think that it would be quite possible to establish a personal equation, and to apply the proper correction.

A much better plan, however, would be to so modify the photometer car itself as to insure the use of both eyes in the inspection of each side of the illuminated disc. Several forms of photometer, already described, partially fulfill the necessary requirement. Any device which would bring the images of the opposite faces of the disc into a vertical line in the field of view would doubtless serve to eliminate the error in question. Observations with such a photometer would correspond in character to the "monocular"

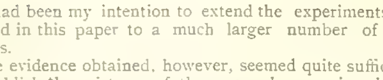

Fig. 10.

readings given in Table 5. Not only would they be free from the systematic error to which the ordinary form of Bunsen photometer is subject, but the accidental errors would be much smaller, and the degree of uncertainty which attends the determination of candle-power by our present methods, would be in great measure diminished.

CORRESPONDENCE.

New York Notes.

[illegible] 2[illegible].—The trial of the alleged electric sugar swindlers was begun Thursday in the court of [illegible] William F. Howard [illegible] Electric Sugar Refining [illegible] Attorney [illegible] the history [illegible]

quickly observed Howard, rising to his feet, "the machine could have been seen long ago," and then he added, with a triumphant and defiant look, "I could show it now if necessary." The case will be continued next week.

The Cumberland Valley company has completed a movable electric light station of wonderful illuminating power. It is an interesting novelty in railroading, and is intended to furnish light for wrecking purposes. The main car is 33 feet long, 9 wide and 13½ high. The floor is iron, and in one end is a 40 horse power vertical boiler and automatic engine, while in the other end of the car are two dynamos, which furnish the current for lights amounting to 4,000 candle power. The car is also equipped with all the conveniences for operating the plant. A car of this description has been operated in Germany some time very successfully, but this is the first one of the kind in the United States.

The trip of the electrical engineers to England and France promises to be an interesting tour. The City of Richmond was chartered, and the City of New York will carry those that cannot be accommodated on the first boat. It is expected that both steamships will arrive at Liverpool at about the same time. On the evening of the arrival of the party the engineers will be formally received by the mayor of Liverpool, and then they will separate, to visit whatever part of the United Kingdom each may desire. They will assemble again about the middle of June at London, where a reception will be tendered by the Institution of Civil Engineers of Great Britain. The lord mayor of London has tendered the use of the Guild Hall, and Windsor Palace will be thrown open for the inspection of the visitors during their stay at London. The latter part of June the party will leave for France, and the Paris exposition will attract and entertain the members of this famous institution of engineers of world-wide reputation.

The New England Julien Electric company is making a good deal of progress with the Julien system of electric railway cars, and their contract with the Union Railway company of Providence shows the advance that has been made. The Julien company will equip all the surface street car roads in Providence with cars built by the John Stevenson company.

The Postal Telegraph company suffered from a lively blaze, caused from an electric spark which flew from a switch board in their operating room, the other day. About a hundred operators are employed, but there were only about six present, as the accident occurred early in the morning. These few got quickly at work with their extinguishers at hand, but the flames spread so rapidly that the city fire department had to be called to their assistance. About a dozen telegraphic instruments, tables and chairs, and the floor and roof of the south side of the building, were burned. The damage will reach over $1,000. The resources of the company are so large that no delay in the service was caused by the fire. W. H. T.

Kansas City, Mo.

Kansas City, May 25.—To a careless observer, street railway enterprise in Kansas City is taking a nap. To an occasional guesser, almost anything is liable to occur.

A careful investigation reveals the fact that schemes are fluttering into life that will, when consummated, well nigh perfect the rapid transit system of Kansas City; but beyond a doubt, no matter how quickly these schemes materialize, the Kansas City of that time, be it only a few months hence, will demand their further attention.

To the Western Electrician correspondent, Colonel Morse, president of the Metropolitan Street Railway company, said: "There is no movement on foot to change the motive power of either the Broadway or the Rosedale line. We expect to operate the Armourdale line by electricity in the early part of June. It seems to be the general public opinion that the policy of the railway people is to substitute cable, electric or steam power for mule power, and perhaps that will be the final result." It is highly probable that should the Armourdale electric line prove successful, the Rosedale line will be the next to be operated by electric power, as there are no heavy grades on that line. Colonel Morse positively denies that there is any definite movement in that line [illegible] company, at present, however.

The [illegible] Valley company, which will build very soon on [illegible], is just completing its arrangements. [illegible] the Independence avenue [illegible] though the deal has not been closed. A [illegible] the leaders of the enterprise said [illegible] doubt whatever about the [illegible] for a few small subscriptions [illegible] assumed. Then we will [illegible] Metropolitan company and begin [illegible] to operate the whole [illegible]

[illegible] the [illegible] of the Kansas City Electric Light company, met with a severe electric shock, one evening last week, which completely paralyzed his right arm and shoulder. He was at work running wire on the south side of Twelfth street, between Main and Walnut streets, when his head accidentally came in contact with a broken wire. The shock he received rendered him almost insensible, but he had presence of mind enough left to hold to the cross piece on which he was sitting, with his left hand, until assistance arrived. The patrol wagon was called, when he was taken to his home. It will be several days before he recovers the use of his arm

The Vine street matter is yet undecided. It is thought, however, that the negotiations will end successfully, and a Thomson-Houston line be constructed.

Charles Rusling has sold a 30 arc and 200 incandescent plant to J Guiney of Pierce City, Mo.; a 50 incandescent light plant to the Western Sash & Door company of Kansas City, Mo.; an increase to the Troost park arc light plant of the Kansas City Cable company, making the total capacity of the park now 50 arcs; a 400 incandescent plant at Tarkio, Mo.; an addition of 100 arc lights at St. Joseph, Mo., all within one month.

Edward Lasell of the Southwestern Electrical Supply company, is making an extended eastern trip.

The Inter-state Electric Light company has reorganized, and new officers have been elected as follows: President, E. P. Brink; secretary, Alexander Simpson; treasurer, S. P. Griffith; general superintendent, Paul W. Bossart. The company proposes many changes and improvements, the most important of which is the erection of a building of its own, in central location, for the plant and offices

An ordinance was to be introduced at the city council of Kansas City, Kan, asking a franchise for the construction of a double track elevated cable or electric street railroad. The line is to extend from North Seventh street to the city limits. In the absence of Mr. Hilliker, the matter was deferred P.

St. Louis, Mo.

St. Louis, May 25.—Work on the new electric conduit system was begun May 10th, and will be continued day and night until finished, D. H. Dorsett, vice-president and manager of the National Subway company, and Geo. W. Le Vin, the company's chief engineer, are in the city. The plans call for a line of conduits about six or seven miles in length extending north and south along Broadway, Fourth, Seventh and Twelfth streets, and east and west along Chestnut and Olive streets, and Washington avenue. Mr. Le Vin recently said: "The system here will be the finest in the world. The conditions under which we are to lay the conduits are more expensive than any by which we have been governed heretofore in similar undertakings. Besides, we will give St. Louis the benefit of improvements not possessed in other places. Each conduit will be separated into two divisions, one for high tension and the other for low tension wires. In each division there will be nine ducts for the cables. The insulation will be thorough. The conduits, which are four feet in length, are fastened together in such a manner as to make them practically one piece. Manholes will be placed at every corner. Space in the conduits will be rented to any electric light company which desires it. About one half the space has been rented already. The cost of establishing the system will be about $36,000 a mile. We expect to have it finished about December. We will work a force, probably, night and day, and will be able to turn out the conduits and ducts in our factory faster than they can be put down here. We can manage to ship four carloads a day to St. Louis, and keep up with our work elsewhere besides. One square will be worked at a time, and closed up before excavations on another is begun. Our force of workmen will at no time consist of less than 150 men."

The longest telephone wire in the city is now being put up over the line of the new water conduits, by the fire alarm and telephone linemen in the employ of the city. It will be ten miles long.

The Board of Public Improvements considers that Chas. Sutter is not progressing rapidly enough in preparing to fulfill his contract for the city lighting in January, 1890. The Laclede company and the Missouri Electric Light & Power company have both begun preparations for the work of lighting the city by electricity in 1890, and the latter company has made considerable progress in this direction, and the officers state that they will be ready to fulfill their contract even before the specified time. The delay of Mr. Sutter is occasioned, it appears, by his inability to arrive at an agreement with the other electric light contractors in regard to the poles to be erected. He refuses to submit to the demands of the other companies, that he furnish seven eighths of the number of poles required and the other companies will listen to no other agreement, so that he cannot proceed. The Board of Public Improvements

has offered to act as a board of arbitration in the matter, and to this end has requested each company to prepare a statement of the amount of wire which will be used by it in lighting the city, from which statement the board will make out the proportionate number of poles to be furnished by each company. As yet, however, none of the companies have seemed to consider the plan favorably.

Mr. Matlock will be appointed supervisor of electric lighting.

There is an important business movement afoot which has for its object the location of express offices doing business in East St. Louis, Ill., the Bell Telephone office and Western Union Telegraph office in one building, soon to be erected on North Main street, near Division avenue. This is a central location in the city.

Mayor Noonan and the Board of Public Improvements, with the exception of Col. Flad, all of whom visited Chicago last week for the purpose of inspecting the various conduit systems in use in that city, have returned home. Col. Flad, instead of coming home directly, left the party at Chicago and went to Minneapolis. They are unanimous in their praises of Chicago's hospitality, and stated that their stay was enjoyable in every respect.

According to the commissioners, the success Chicago has had in securing the general adoption of the underground system is something remarkable. "If St. Louis can be as successful in the enterprise as Chicago has been," said one of the commissioners, "why, by all means let us have underground conduits as soon as possible, provided a suitable system can be secured."

The advantage of having the wires buried in cases of fire was opportunely demonstrated during the stay of the St. Louis party in Chicago. C.

THE ELECTRIC LIGHT.

The Edison Electric Light company of St. Paul gave a public exhibition of its fuel oil plant May 21st.

The Baltimore, Md., city council recently decided to reopen the controversy over the contract for electric lighting in the city.

Marion Electric Light & Power company, Marion, O., has placed an order with the Schuyler Electric company for an immediate increase.

The Westinghouse company of Pittsburg, furnished the engine used in the electric lighting of the great Tarzuela at Madrid, the largest theater in Spain.

The Spanish-American Light & Power company of Havana, Cuba, has completed its new plant, which is now in successful operation. Westinghouse machines are used.

The Schuyler Electric company has just installed a dynamo with full complement of lamps in the station of the Anthracite Electric Light & Power company, Pottsville, Pa.

The Englewood, Ill., Electric Light company has added a 1,500-light dynamo to its installation, making the capacity of the plant 2,250 lights. The Westinghouse alternating system is in use.

The prospectus of the Union Electric company of Australia has just been issued. The company has a capital stock of £1,000,000, and was formed to succeed the Electric Light & Power Supply company, limited, of Australia, and the Southern Electric company of Melbourne.

The Westinghouse company reports the following recent contracts for alternating current, central station outfits: Middleboro, Mass., 750 lights and a 35 arc light outfit; Port Jervis, N. Y., 750 lights; Englewood, Ill., 1,500 lights; Birmingham, Ala., 500 lights; St. Helena, Cal., 500 lights and a 20-light arc outfit.

A Vienna note says: "The attention of the electrical world here is directed to the constitution of the International Electric company, limited, the capital of which is £100,000. It is to erect central stations at Vienna, Budapest and elsewhere. Mr. Déri, one of the inventors of the Ganz transformer system, is named as manager of the large Vienna establishment which is to be built."

The Thomson-Houston company of Chicago reports the following recent sales: New local companies—Alexandria, Mich., 300 incandescent light plant; Pierce City, Mo., 30 arc and 200 incandescent light outfit; Plattsmouth, Neb., 35 arc and 600 incandescent light plant; increase—Galesburg, Ill., 35 arc; Janesville, Ill., 45 arc, isolated—Martin Ryerson building, Chicago, 50 arc; Fairbanks Canning company, Chicago, 70 arc and 1,000 incandescent; Cheboygan, Mich., Lumber company, 5 arc; Illinois Steel company, Joliet, 200 incandescent; Minneapolis Exposition building, 150 arc and 1,200 incandescent.

A Minneapolis paper says: The Edison Electric Light & Power company have asked to be assigned space twenty-four inches wide, twenty inches deep, and next to the curb in the trench which the council has ordered for the underground wires. The city engineer has not granted the permit yet, but will in a day or two, just as soon as he is determined how deep in the trench the company must lay their pipes. When this is determined the company will go to work in earnest, and in ten days will have down all the wires needed for their system at present. It will not take them long to get things in running order when once they are started. In fact, their system is already running in one block of the city, the one where their building is located. The building is but partially completed, and yet the basement is [illegible] equipped with engines and [illegible]. They have three engines in already, and [illegible] [illegible]. [illegible] give a 1,200 horse power. The building is constructed to accommodate [illegible] [illegible] horse power. The building [illegible] [illegible] [illegible] the Lumber Exchange [illegible] block [illegible] Bank of Commerce. The building when completed will be quite a curiosity. The power [illegible] every one of the [illegible] there will be no belting or shafting whatever.

The Westinghouse Electric company has [illegible] the country into districts, appointing in each an agent, who is given charge of the selling business throughout his district. The representatives in their several districts are: W. [illegible] A. Casey, 620 Atlantic avenue, Boston, Mass.; [illegible] [illegible], 120 Broadway, New York; D. A. Tompkins, Charlotte, N. C.; J. H. Gates, Marshall, Texas; W. [illegible] San Francisco, Cal.; Guido Pantaleoni, St. Louis, Mo.; George O. Fairbanks, the Rookery building, Chicago, Ill.; A. T. Moore, Jr., Denver, Col. H. W. Cook, agent for the Northwest, has not yet established an office, but will doubtless be located at St. Paul or Minneapolis.

Among the recent sales of the Western Electric company of Chicago are the following: Milwaukee Electric Light company, 2 600-light incandescent dynamos; Bijou Opera House, Milwaukee, Wis., 545 incandescent light plant complete; Sonnenfeld Millinery company, St. Louis, Mo., 35-light high tension arc dynamo; E. E. Wood, McCook, 1 20 light arc dynamo; C. Jevne & Co., Chicago, 75-light incandescent outfit complete; Grand Pacific Hotel, 1 40 light high tension dynamo; Bradshaw & Waters, Chicago, 50-light incandescent outfit, with wiring, steam power, etc., complete, for the boat, Mabel Bradshaw. The company will also wire the residence of C. P. Thomas, Oak Park, for incandescent lights.

A Pittsburg paper of May 23 says: "The stockholders of the Allegheny county Light company and the Pittsburg Light company met yesterday in their offices, in the Westinghouse building, to vote on a proposition to accept the provisions of the new act of assembly for the incorporation and regulation of corporations to supply light, heat and power by electricity. This action was explained as being taken for this reason: The two companies were incorporated under the act of 1874, which authorized companies to furnish light, heat and power, but no provision was made for electric light, because electricity was not then in use. But the amendment, which passed May 9th, makes provision for electricity, and the companies will have to return their charters to Harrisburg to be legalized under the new act."

THE ELECTRIC MOTOR.

The Cream City car line of Milwaukee contemplates introducing the storage battery system on its road.

William H. Bryan, for many years connected with the Pond Engineering company, and whose specialty was the department of steam plants for electrical service, has identified himself with the Heisler Electric Light company of St. Louis, Mo.

The Omaha Motor company is extending its lines. The proposed new lines extend over twenty-four blocks. The company has already begun experiencing trouble in the way of injunctions, but it hopes to succeed in these as in its former litigation.

The East Cleveland Railroad company's ordinance was brought up in the council at its last meeting and an attempt was made by the old companies to prevent the motor company from extending its road to the center of the city. It failed, however, as it was apparent the people wanted electric roads.

The Sprague Electric Railway & Motor company recently closed a contract for electric railway apparatus at Pittsburgh, Pa., for twenty-five cars, with complete station equipment and overhead line system, to be operated by the Federal Street & Pleasant Valley Railroad company. The road will run through the most important streets of the city, and the overhead work will be of the lightest description. Iron poles will be used, and every improvement will be utilized on this line.

The line for the Seattle electric street railway has been surveyed. This line, if built, will be about four miles in length, and will form a valuable addition to the electric railway system. It is thought that it will not be operated by the Seattle Electric Railway & Power company. The Seattle Electric Railway & Power company has arranged for trebling the power of its plant. At present it has in operation in its power house a 100 horse power engine, which furnishes power for operating an 80 horse power dynamo. Two engines of 100 horse power are to be added, and also two 80 horse power dynamos. These are to be used to operate additional cars, and also in furnishing power in the city. Four new cars recently ordered will soon arrive, and will be placed on the road as soon as the new machinery is in operation.

The following circular has been issued by the Davenport Central Railway company and the Stillwater Street Railway company: "It is time that the electric railway companies form an association for mutual benefit and protection. It is the experience of all lines that the charges made by electric manufacturers for supplies are exceedingly high, if not exorbitant. Moreover, the repairs on motors and car equipments form a most serious question, and we all need the experience of the engineers of the different roads throughout the country in consultation in order to bring about such changes as may reduce these excessive charges for repairs and renewals. In order to obtain your views, we earnestly invite you and any other members of your company to be present at a meeting of electric railway men, to be held in Davenport, Ia., June 20th and 21st."

THE TELEGRAPH.

[illegible]

Personal Paragraphs.

[illegible]

before his return.

Business Mention.

W. M. T[illegible] of Chicago [illegible] motors manufactured by the Queen City Electric company of Cincinnati.

The Holt[illegible] Electric company [illegible] Boston, has just completed in [illegible] lamps at the Boston museum. The introduction of electric lights was made necessary to avoid the heat in summer months.

H. A. Kinny and A. H. Zeh[illegible] [illegible] the Nebraska Telephone company of Omaha [illegible] the most attractive electrical establishments in the west. They have an excellent line of supplies, and report an excellent business.

The Pond Engineering company [illegible] engine foundation for the Union railway, St. Joseph, Mo. The boiler and pump for Madison, Neb., [illegible] being set up. The Pond company makes a specialty of pumping outfits and large sewerage pumps.

The Electrical Supply company of Chicago has just issued a new catalogue descriptive of electrical house goods supplies. It is a book of over 100 pages, [illegible] carefully prepared, and tastefully arranged. Besides showing a complete line of batteries, bells, [illegible] annunciators, there are shown in the catalogue [illegible] gas lighting apparatus, tools designed especially for electricians, and a complete set of wiring diagrams [illegible] houses. The catalogue contains information of value to those interested in this class of work.

Electrical Patents.

[illegible] May 21, 1889.

403,515. Railway Signal. Thomas A. Casey, New [illegible].

The invention relates to the class of railroad signals which electrically register the number of cars passing over a certain section or block of the road, and simultaneously produce a visual signal indicating the passage of said cars into and out of said block of road.

"The first claim reads: "In combination with the normally-closed circuit, circuit breaker, electro-magnetic registering instrument and signal in said circuit, and said registering instrument actuated by electric impulses produced by intermittent closing of the circuit, a shunt normally open and forming then a more direct connection of the signal with the circuit and closed by the first break of the circuit and before the registering mechanism is actuated.

403,517. Electro-Magnet and Armature. Frederick W. Cole, Newton, Mass.

The first claim reads as follows: "The combination with an electro-magnet having a pole piece with converging surfaces, of an armature composed of two portions, one of which is arranged [illegible] substantially parallel with one of the surfaces of the pole piece, and the other of which portions [illegible] and recedes from the other surface of said pole piece.

403,541. Electrical Converter. Hermann Lemp, [illegible], Mass.

The object of the invention is to [illegible] and effective form of converter especially [illegible] obtaining currents of low potential [illegible] suitable for use in electric welding [illegible] working operations. The invention [illegible] ally, in the combination, with [illegible] of one bar [illegible] one set of the [illegible] piece of [illegible] one, and [illegible] the other set [illegible] [illegible]

[illegible]

403,5[illegible]. Means for Operating [illegible] Electricity. John M. Orford, [illegible]

The first claim is given: "The [illegible]

apparatus for electrically actuating draw-bridge spans, with a cable containing the circuit wires and extended beneath the channel, of a pair of brushes connected to said cable and rigidly secured upon the abutment, a pair of continuous copper conductors secured upon and movable with the draw span and engaged by said brushes, a motor connected to said conductors and geared to the driving pinion, and suitable mechanism, as a rheostat and switches, interposed between the conductors on the span and the motor, whereby the speed and direction of rotation of the motor may be governed."

403,575. Machine for Separating Iron from Ores. Gurdon Conkling, Glens Falls, N. Y.

403,576. Magnetic Separator. Gurdon Conkling, Glens Falls, N. Y.

The invention consists in the combination, with a conveyor for supporting the mass to be treated, of a magnet, a disk revolving independent of the conveyor and magnet at a point between said conveyor and magnet, and means for revolving the disk.

403,593. Secondary Battery. Augustus Jamieson, Elizabeth, N. J.

We give the first claim: "The method of generating electric currents, which consists in forming a coating of sulphate of lead upon the surface of lead electrodes by immersion in sulphuric acid, converting the sulphate on one half the electrodes into sulphide of lead by immersion in a reducing agent—such as sulphide of sodium—converting the sulphate on the other half of the electrodes into plumbic peroxide by immersion in an oxidizing agent—such as hypochlorite of soda—replacing the electrodes in pairs in the sulphuric acid to form a battery, and connecting them up in an electric circuit."

403,619. Switch Instrument for Railroad Signals. George C. Steenbergh, Syracuse, N. Y.

The invention is designed to operate automatically electric circuit making and breaking apparatus by the shifting of switch rails, and to be used in railway signaling devices.

Claim 1: "The combination, with a block of railway main track and siding connected with said block, two electric circuits, circuit breakers at each end of the block connected with said circuits and actuated separately by the cars passing over the block of road, registering mechanism in the circuits actuated in opposite directions, respectively, by the circuit breakers at opposite ends of the block, and signals actuated by the registering mechanism, of two circuit breakers separate and independent of the circuit breakers at the ends of the block and connected, respectively, with the two circuits and actuated separately, one by the movement of the switch rod in opening the switch of the siding and the other by the movement of the switch rod in closing said switch."

403,624. Magnetic Ore Separator. William R. Thomas, Catasauqua, Pa.

The last claim reads: "4. An ore separator consisting of a vertical endless belt, a magnet having its field located behind the vertically descending portion of the endless belt, a receiving chute opening onto the endless belt above its upper roller, a directing chute with closed top open at its lower portion opposite the endless belt and its upper roller, a chute having its upper end located opposite to the endless belt below the field of the magnet, with a passage way between the belt and chute and an air-exhaust tube, and mechanism connected with the upper end of the directing chute."

403,62[illegible]. Telegraph Sounder. Frank L. Van Epps, Hudson, Mich.

403,630. Dynamo Electric Machine. Thomas L. Willson, Brooklyn, N. Y.

The invention relates to dynamos of the general class known as "open coil" machines, or those in which the armature conductors are cut out of the external circuit as soon as they pass out of the effective magnetic field of force and are left with open terminals during their period of inactivity.

Claims 2 [illegible] and [illegible] are appended: "2. A dynamo armature consisting of a cylindrical iron core mounted on a revolving shaft, and a layer of independent and [illegible] open circuited conducting bars insulated [illegible] extending longitudinally over the cylindrical core and fastened thereto, so as to rotate [illegible].

"[illegible] The combination, with a field magnet formed with converging poles of alternately contrary polarities [illegible] armature consisting of a [illegible] mounted to rotate on said axis, [illegible] longitudinal conducting bars [illegible] fastened to said core, and [illegible] the end of the poles [illegible] two series of com[illegible] arranged at each end to [illegible] surface, and each series [illegible] arranged concen[illegible]

"[illegible] magnet having con[illegible] alternately-contrary polarities, an [illegible] layer of longi[illegible] to rotate within [illegible] equal in [illegible] against [illegible] of force, [illegible] segmental [illegible] at their [illegible] and adapted [illegible]

[illegible] Me. [illegible] appended [illegible] with their [illegible]

peripheral face in contact with the edge of carbon disks, whereby the surface speed of the carbon disks will always be the same until the disks are burned out."

403,691. Electrical Switch for Elevators. William E. Nickerson, Cambridge, Mass.

The invention relates to an electric switch device located within an elevator carriage, by means of which the attendant can cause the circuit in the electrodes to be closed or opened at will, and also to set the switch in such a manner that the carriage will stop automatically at any floor, either in going up or down.

The second claim is:

"In an electric switch device for elevator carriages, the combination of the electrodes, arranged in offsets, with a brush-holding arc upon the elevator carriage having brushes and contact devices adapted to move laterally, and also in and out of contact with the electrodes."

403,707. Process of Electric Soldering, Brazing and Welding. Elihu Thomson, Lynn, Mass.

Claims 1 and 3 are appended:

"1. The herein-described method of electric welding, brazing or soldering, consisting in passing through one or both of the parts or pieces to be operated upon a heavy electric current in the general direction of the line or plane of the joint and of a volume sufficient to bring the piece or pieces to the requisite temperature.

"3. The herein described process of forming longitudinal seams or joints in or between elongated metal pieces, consisting in passing a heavy electric current through the piece or pieces longitudinally and of a volume sufficient to heat the same to the desired welding or brazing temperature."

403,708. Method of Electric Welding and Brazing. Elihu Thomson, Lynn, Mass.

The invention relates to methods or processes of forming welded or brazed joints between two metal pieces or portions of a metal object; and it consists, essentially, in passing a heating electric current through the material from one side to the other of the joint, and then, when the material is properly heated, subjecting the joint itself to compression by suitable tools forced upon the joint in a lateral or transverse direction—that is to say, in a direction transverse to the general common line or plane in which the joint and the object or portions of object adjacent to the joint and on either side thereof, lie.

403,727. Insulator. Jacob C. Berrang, Asbury Park, N. J. Filed April 2, 1889.

403,752. Method of Operating Electric Furnaces. John C. Hobbs, Lockport, N. Y.

403,754. Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

Two of the several objects of the invention are, first, to arrange the rails of a straight railway on different levels and place the conduit containing the working conductors next to the highest rail, so that the water and slush shall run away from the conduit and also be out of the line of travel of the horses; second, to provide the car with an approved device for taking the electric current from the working conductors within the conduit. Claims 1 and 9 are given:

"1. A road-bed for an electric railway in which one rail is higher than the other, and the roadway between the rails is inclined in combination with an electric conductor arranged at or near the higher rail.

"9. The combination of a slotted conduit, working conductors contained therein, a frame projecting down through the slot of the conduit and provided with two guide rollers to run in the slot and guide the frame, brushes carried by said frame to form electrical contacts with said working conductors, depending conductor guards arranged between and close to said rollers and projecting through the slot, and insulating conductors passing through said guards and having electrical contacts with the working conductors."

403,776. Individual Call and Switch. Edwin Pope, Quebec, Quebec, Canada.

The second claim is: "The combination, with the bell magnet and armature in an ordinary telephone box, and with the telephone, of a short circuit around the telephone controlled by the position of the armature, a rod or pin attached to the armature normally held by a notched wheel, so as to close the short circuit, and an electro-magnetic escapement in the main line operatively connected with the wheel."

403,786. Electric Railway. Francis M. Speed, San Francisco, Cal.

The first claim is given:

"In an electric railway conduit, the combination which consists of a conductor having an inverted U-shaped cross-section, its open side down, a strip of insulating material parallel with and in the interior of said conductor, insulated and supported from the conduit walls, and insulators interposed between said conductor and said strip."

403,800. Slotted Conduit for Electric Conductors. Charles J. Van Depoele, Chicago, Ill.

The invention comprises a specially constructed tube or conduit, within which the main supply conductor is carried along the line of the railway, and means for insulating said conductor from its support within the conduit tube, and for establishing and maintaining a continuous contact therewith.

The invention further includes devices for clearing the tube from extraneous matter, such as would ordinarily find its way thereinto.

The first and third claims read:

"1. A metallic conduit for electric conductors, having a continuous interior lining of insulating material and a conductor and independent supports therefor within the conduit.

"3. A metallic conduit for electric conductors, having a continuous interior lining of insulating material, provided with outlets at suitable distances, and connections between said outlets, and a continuous drain independent of the conduit structure, and extending along the line of the conduit."

403,801. Electric Railway. Charles J Van Depoele, Lynn, Mass.

The invention relates to new and improved means for constructing and operating electric railways, and it consists in the mode of applying the power of the electric motor to the driving wheels of the cars, as also the mode of conveying the electric current from the generator to the motor.

Claims 6 and 9 are:

"6. In a system of electric railroading where a large number of vehicles are electrically propelled at one time and from the same source, a means for regulating the current by an additional resistance in circuit with each motor at the time of starting, preventing the short circuiting of the current by placing such resistance in each motor circuit independent of the other and corresponding to the electro-motive force of the current employed, and means for gradually withdrawing said resistance as the motor attains a certain speed.

"9. In an electric railway system, the combination of poles or supports placed on each side of the line of way, supporting wires extending across the line of way and secured to opposite pairs of poles or supports, a conductor or conductors arranged below the cross-wires and above the line of way, ears or bails permanently secured to the upper side of the conductor or conductors, and insulating devices connected with the ears or bails, and the cross wires for sustaining the conductor or conductors, and an upward pressing contact wheel engaging the under side of the conductor."

403,802. Galvanic Battery. Joseph C. Vetter, New York, N. Y.

The first claim is given:

"A battery cell having a partition extending from side to side of porous material, said partition being sealed in at the bottom with paraffin or other wax."

403,825. Underground Conduit for Electrical Conductors. Charles B. Cole, Detroit, Mich.

403,834. Mechanical Musical Instrument. Willard H. Gilman, Boston, Mass.

Claim 3 is given:

"3. As a new article of manufacture, the combination, with the casing, having a receptacle for the battery, of the battery located therein, a series of bells, mounted upon the casing in a suitable manner, electro magnetic means for actuating severally said bells an electric circuit extending from said battery to said electro magnetic means, a series of spring circuit controllers severally connected in said electric circuit and normally resting upon the face of the metal cylinder, a metallic cylinder also included in said electric circuit, a sheet of flexible material provided with perforations arranged to pass between said spring circuit controllers and said cylinder and mechanism for feeding said perforated sheet between the circuit controllers and cylinder, the whole being mounted upon a suitable casing, in the manner shown."

403,836. Dynamo Electric Machine. Alphonse I Gravier, Paris, France.

Claims first, fourth and sixth read as follows:

"1. In combination with the rotary armature of a dynamo electrical machine, field magnets provided on each side of said armature with two electro-magnetic cores of unequal magnetism and additional polar portions of less magnetism than either of said cores arranged after them in the direction of the armature's rotation, the cores of higher magnetism being in advance of the other cores, and the said additional polar portions being magnetically connected with the magnetic frame of the machine intermediate the said cores of less magnetism of one pole and the bases of the more highly-magnetized cores of the succeeding pole.

"4. In combination with the rotatory armature of a dynamo-electric machine, field magnets provided with cores of like polarity differing in cross section and arranged with smaller cores in advance of the larger core or cores of the same polarity.

"6. In combination with the rotatory armature of a dynamo electrical machine, field magnets having cores with their axes of winding transverse to the armature axis and their polar ends turned toward the armature and provided with a prolongation extending from one side of a core of each pole, and fastened at its outer end to the base or bases of the core or cores of the opposite pole, the prolongations lying on opposite sides of the armature and forming a magnetic yoke or frame of the machine, as well as polar portions for distributing field magnetism to the armature."

403,868. Galvanic Battery. Don J. Arnold, Omaha, Neb.

The first and third claims read.

"1. A galvanic battery composed of a receiving and retaining jar and a solid filling consisting of litharge, chloride of zinc, muriate of ammonia, oxide of mercury, and a cement, as plaster-of Paris or hydraulic cement, a carbon or carbons, contact posts, and a sealing cap of asphaltum or mineral pitch.

"3. A galvanic battery consisting of a jar, a plurality of round carbons contained therein, a clamp in closing and binding said carbons together, contact posts connected, respectively, to said carbon clamp and jar, a solid filling surrounding said carbons and filling the spaces between the same and the jar, and a sealing cap or cover, whereby the battery is rendered incapable of being affected by atmospheric influences and can be readily transported from place to place without injury to or displacement of the current-exciting filling."

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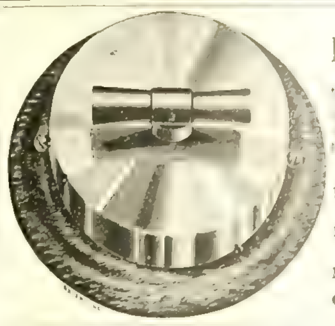

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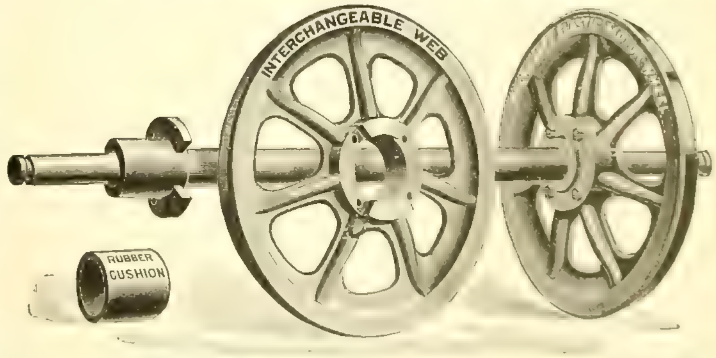

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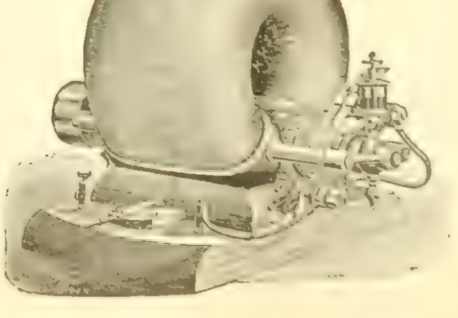

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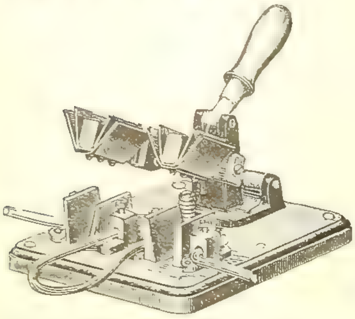

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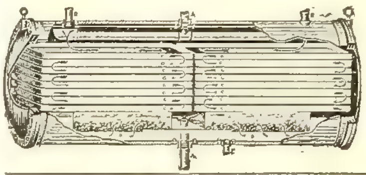

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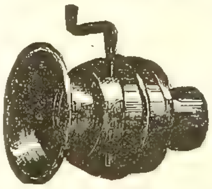

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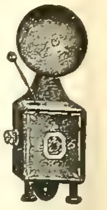

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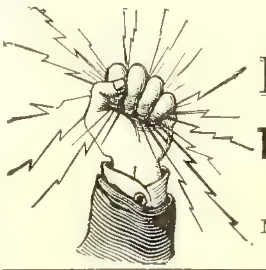

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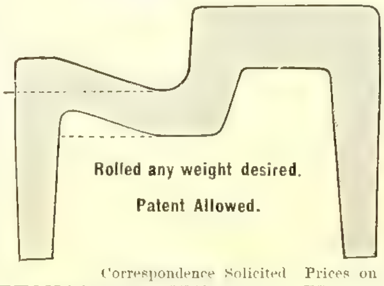

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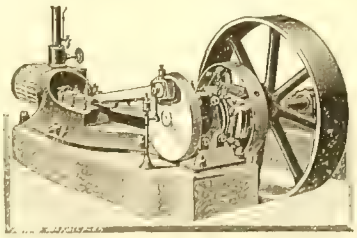

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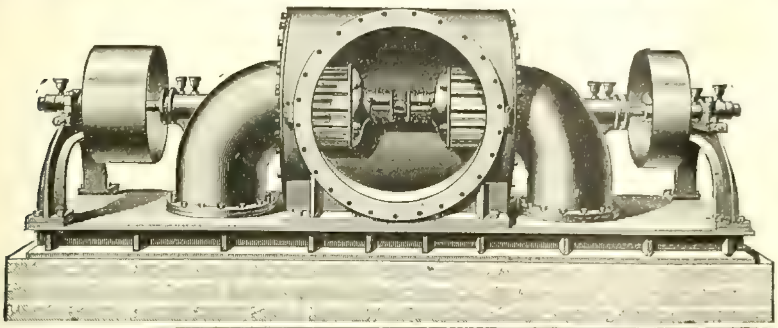

The attention [illegible] **CELEBRATED WATER WHEEL** [illegible] on account of it **remarkably steady motion, high Speed and great Efficiency,** [illegible] **large Capacity,** [illegible] diameter, being **double** the **Power** [illegible] number of the [illegible] ical use of water [illegible] ful effect **guaranteed.**

SEND FOR CATALOGUE AND PARTICULARS.

Our Horizontal "Victor" [illegible] recommended, [illegible] and it can be belted directly to dynamo.

The accompanying engraving [illegible] a pair of [illegible] **VICTOR TURBINES** [illegible] Tubes, End Bearings for Shaft, and [illegible] a substantial cast-iron [illegible] The entire arrangement [illegible] strictly first-class in every particular. We are now prepared to furnish Victor Turbines, either single or in pairs on horizontal shafts, and where the situation admits of their use, we recommend them.

STILWELL & BIERCE MFG. CO., - DAYTON, OHIO.

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FACTORIES: WATERBURY, CONN.

MANUFACTURERS OF

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Underwriters' Copper Electric Light Line Wire, handsomely finished, highest conductivity. Copper Magnet Wire, Flexible Silk, Cotton and Worsted Cords for Incandescent Lighting. Round and Flat Copper Bars for Station Work. Insulated Iron Pressure Wire.

TRADE "K.K." MARK

PATENT "K. K." LINE WIRE

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For Electric Light, Electric Railways, Motors, Telegraph and Telephone Use.

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MAKERS OF HIGH-GRADE CARBONS FOR ELECTRIC LIGHTING

THE MOST DURABLE, SIMPLEST AND BEST

OVERHEAD WIRE SYSTEM.

Bentley-Knight Electric Railway Co.,

25 & 27 Tenth Ave., NEW YORK CITY.

The ONLY Conduit System.

WE ARE OFFERING A

FIRST CLASS IRON BOX BELL 2 1-2 OR 3 IN.

HIGHLY ORNAMENTED

And a Good Ringer, on 1 or 4 cells of battery, at 55c. in lots of 25, or 60c. in lots of one dozen.

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FISHER-RAE ELECTRIC RAILWAY SYSTEM

For Street and Suburban Traffic.

Embraces new and valuable improvements which are requisite to economical operation, and high efficiency. The

ONLY SUCCESSFUL SYSTEM USING UNDERGROUND CONDUCTORS.

8 MILES OF CONDUIT IN ONE ROAD AT SAN JOSE, CAL.

Overhead Conductors.

IMPROVED TROLLEY AND TROLLEY SUPPORT line of neatest design. Avoids "flashing" at wheel or line contact.

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Contains new features that will commend it to the careful attention of Street Railway Managers looking for reliable, easily operated and efficient electrical apparatus, designed to stand the test of work.

The Fisher-Rae System

Can be placed upon existing roads without alteration of track or road-bed, and upon cars in use, without interruption to traffic of road.

POINTS OF SUPERIORITY.

A SINGLE MOTOR GEARED TO BOTH AXLES WITH IMPROVED NOISELESS GEAR.

FLEXIBILITY BETWEEN MOTOR AND CAR AXLES, INSURING CLOSE MESH AND PREVENTING BREAKING FROM SUDDEN STRAINS.

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Combined Rosette and Cut-Out.

For Flexible Pendent Electric Lights.

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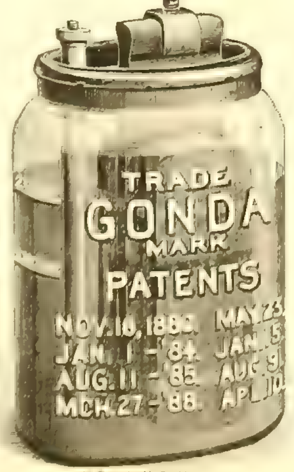

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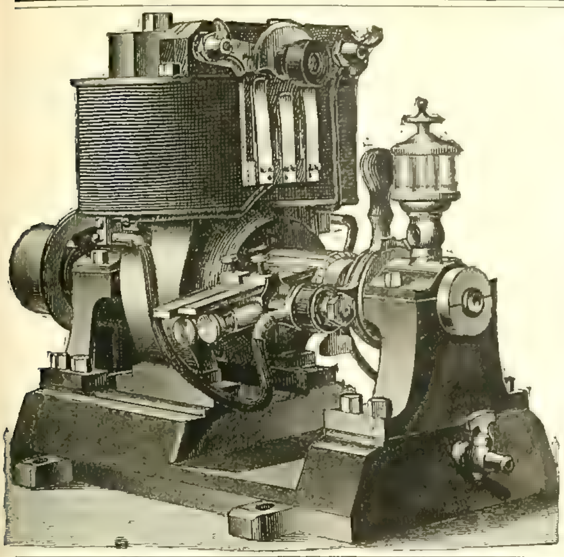

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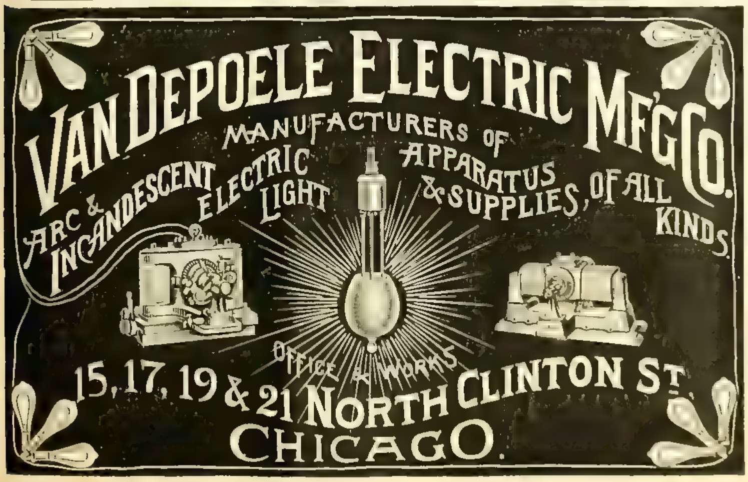

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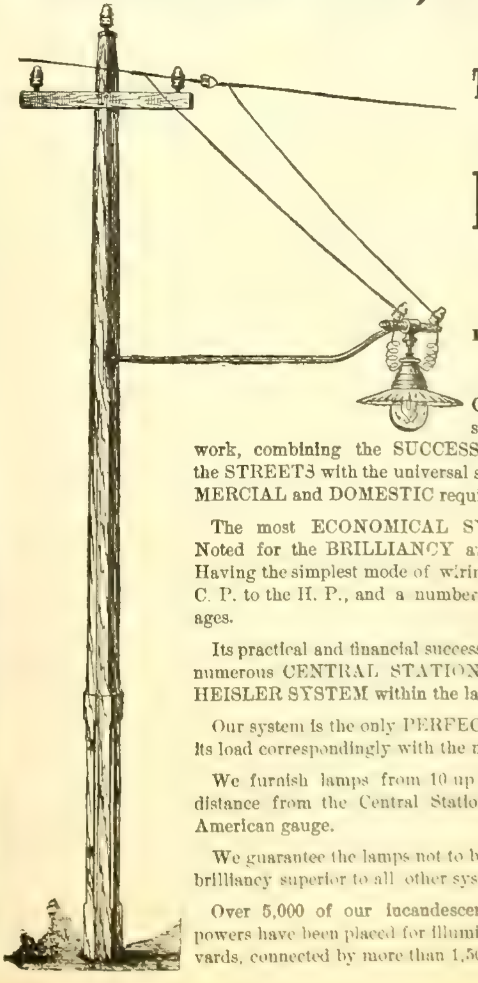

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The only INCANDESCENT SYSTEM especially suited for Central Station work, combining the SUCCESSFUL ILLUMINATION of the STREETS with the universal supply of light for all COMMERCIAL and DOMESTIC requirements.

The most ECONOMICAL SYSTEM in every respect. Noted for the BRILLIANCY and BEAUTY of the light. Having the simplest mode of wiring, the greatest production of C. P. to the H. P., and a number of other important advantages.

Its practical and financial success has been demonstrated by numerous CENTRAL STATIONS which have adopted the HEISLER SYSTEM within the last three years.

Our system is the only PERFECT AUTOMATIC, adjusting its load correspondingly with the number of lights.

We furnish lamps from 10 up to 100 C. P. to any desired distance from the Central Station on a single wire, No. 8 American gauge.

We guarantee the lamps not to blacken and to maintain their brilliancy superior to all other systems.

Over 5,000 of our incandescent lamps of various candle powers have been placed for illuminating the streets and boulevards, connected by more than 1,500 miles of line wire circuits

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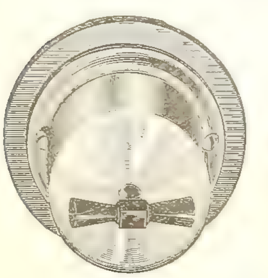
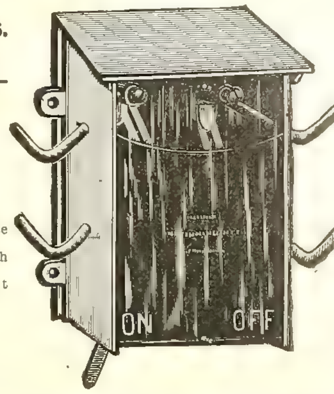
GANG SWITCHES, FROM 5 TO 40 AMPERES.

Quick Make and Break Uncontrolled by the Handle.



Correspondence Solicited with Electric Light Companies.



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MASTER MECHANICS, Purchasing Agents, Engineers and Practical Builders of costly steam plants will be pleased to know that a Lubricant is now produced of such extraordinary high fire test as to make it proof against the great heat to which it is subjected, and is therefore a PERFECT lubricator where products of lower grade and fire tests pass off at once, leaving the parts subject to wear, or greatly increasing the consumption of oil.

"**Valve-Oleine**" is a product in the highest state of filtration, is of the greatest viscosity, is entirely free from all acids and absolutely non-corrosive, and without doubt the finest and most thoroughly reliable Cylinder Lubricant now on the market and will naturally lubricate 200 to 300 PER CENT. more than products of lower test. ☞ Is not only the **best** but the most **economical** lubricant.

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Samples of one to ten barrels shipped on request. Correspondence invited. Resident agents wanted.

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AGENTS FOR OUR FIXTURES IN THE NORTHWEST.

WHO IS

The Pioneer in the Development of the Incandescent Electric Light System?

FACTS OF THE PRESENT CONTROVERSY.

THE NATIONAL ELECTRIC MANUF'G CO.

HOLDS THE KEY TO THE SITUATION

BEWARE OF IMPOSTORS.

"SUUM CUIQUE"

TO USERS OF ELECTRIC LIGHT APPARATUS:

The Edison and Sawyer-Man Electric Light Companies have recently deluged the country with circular letters and bombastic advertisements, setting forth that they have patents, which cover the fundamental principles of electric lighting; and that their patents have been sustained in the Supreme Court giving the exclusive right to manufacture and operate incandescent lamps. Nothing could be more misleading than such statements.

Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simply a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

This company takes the position: First, to defend the users of its apparatus against loss accruing from its use; second, to vigorously and determinedly prosecute Walter K. Freeman's claims for patents covering these inventions.

Our apparatus is of the highest efficiency—mechanically and electrically. We are prepared to guarantee its operation and defend our customers.

We are in this business on a business basis, for a manufacturer's profit; having all modern facilities for the production of first class apparatus. We solicit the patronage of electric light users, believing we can furnish the best.

OUR
Dynamos, Lamps,
and Converters
are guaranteed
to be the most
perfect, mechani-
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Our prices are
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CAN.

GET THE BEST. *Representatives wanted in every State in the Union.* **GET THE CHEAPEST.**

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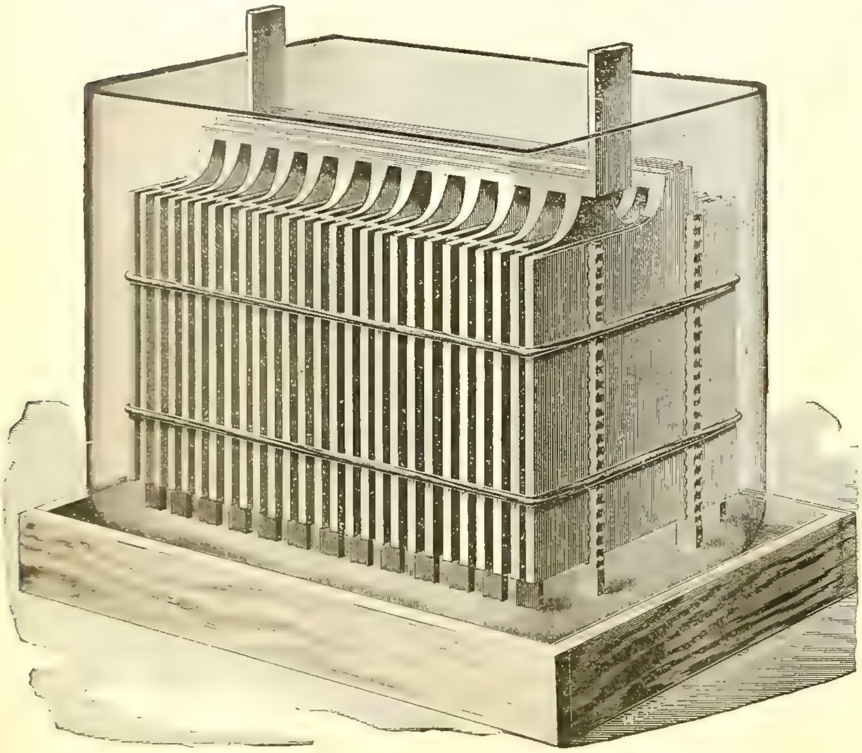
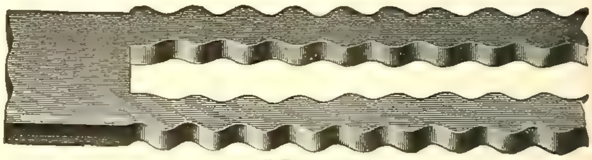
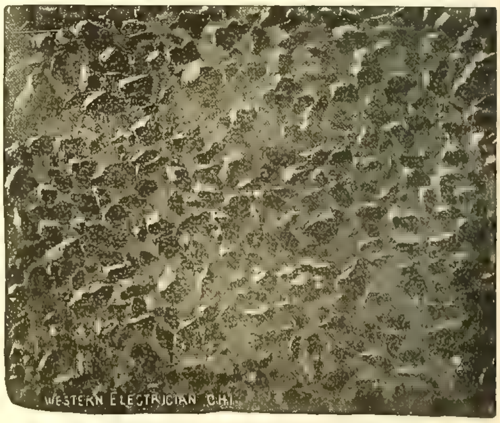


BATTERY.



DIVIDER.



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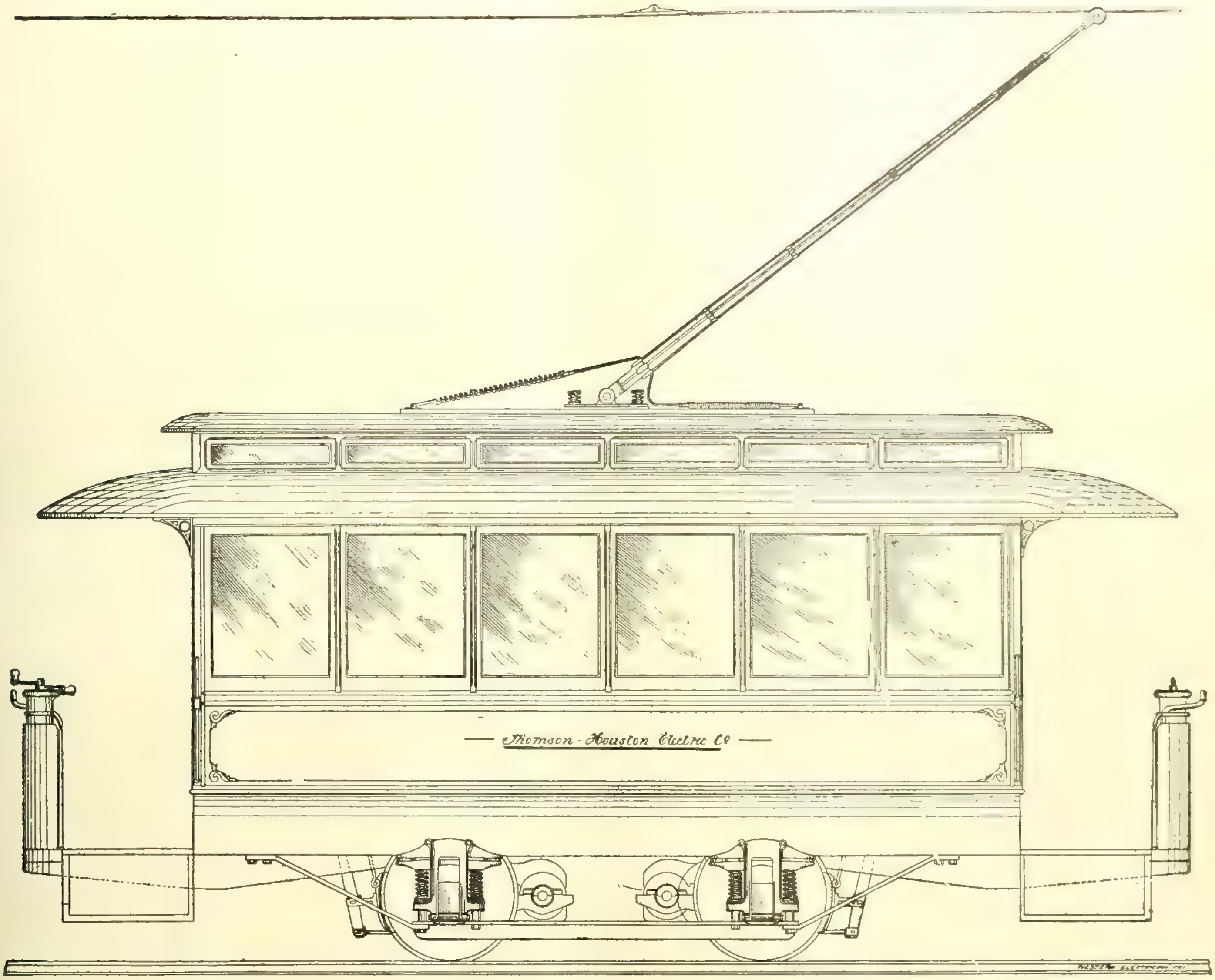

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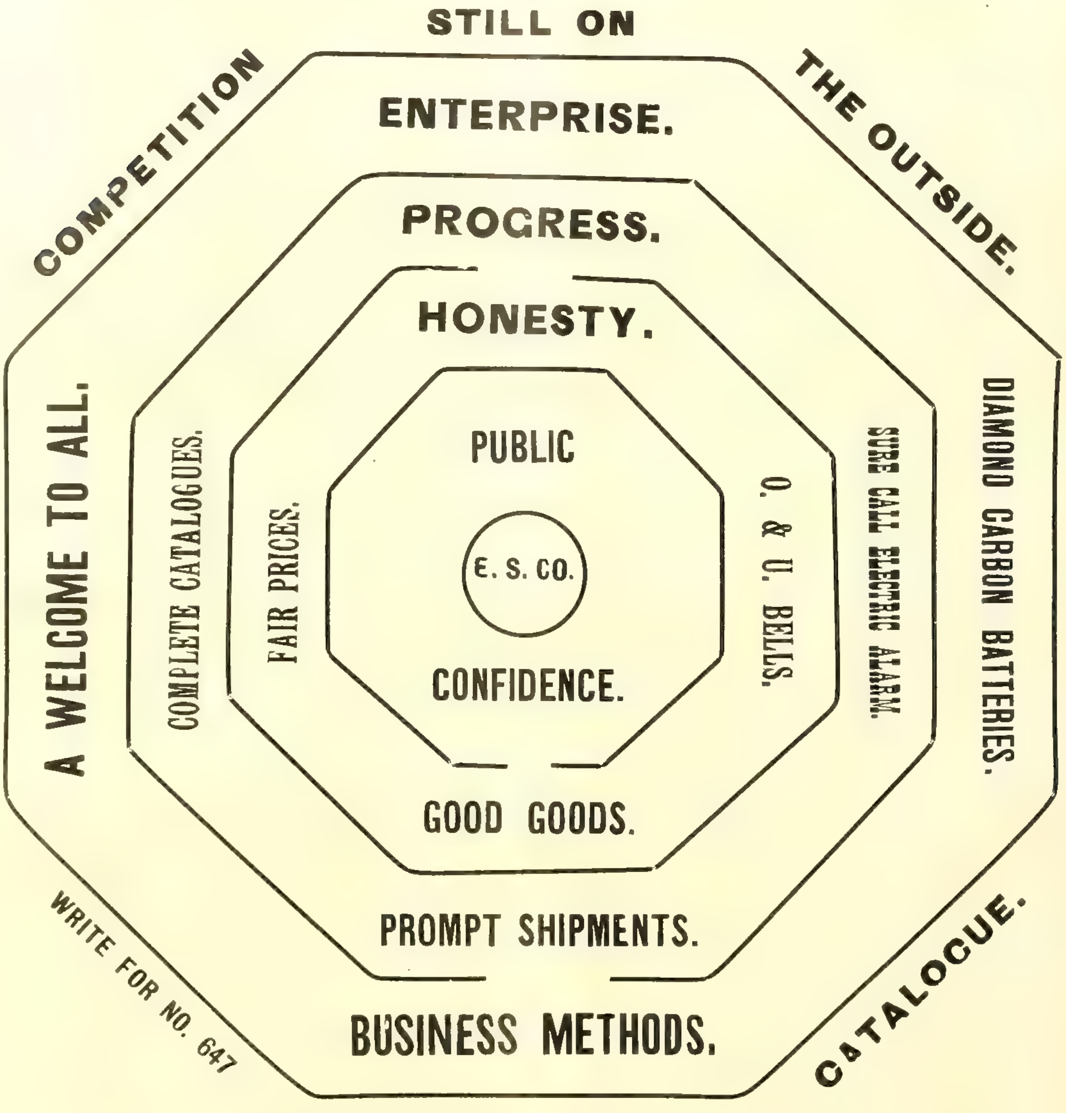

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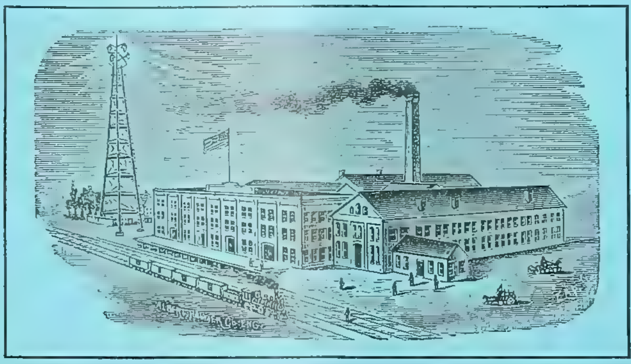

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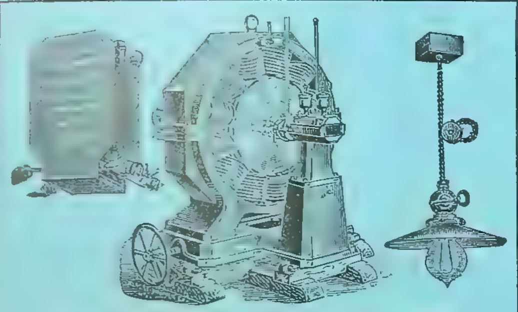

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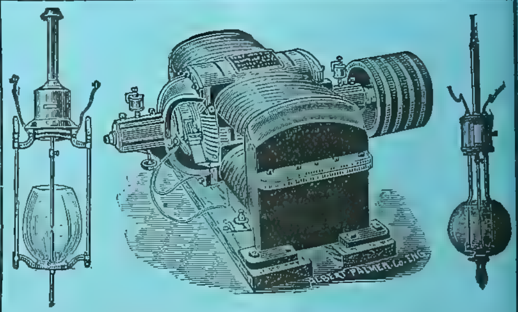

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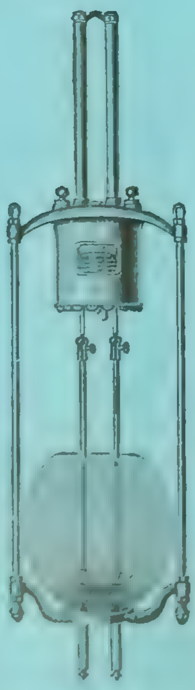

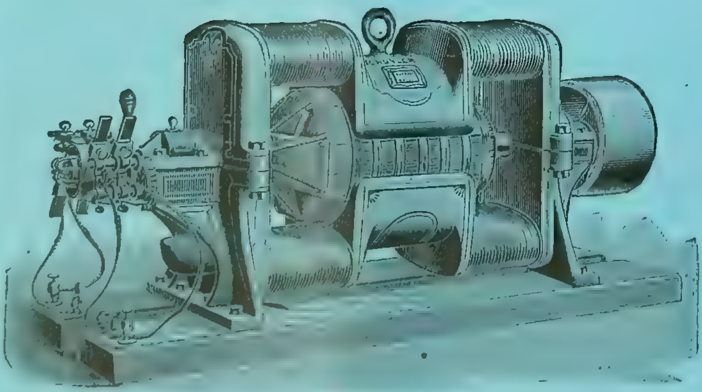

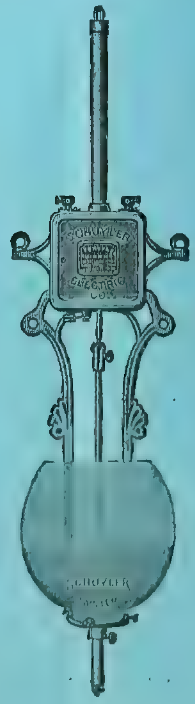

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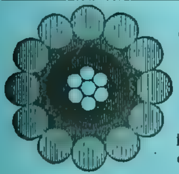

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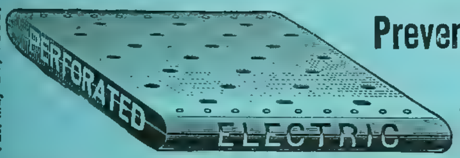
Pat. May 24, 1888.



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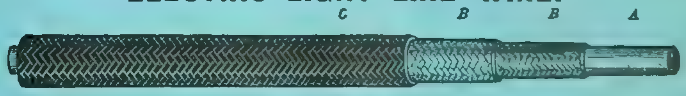

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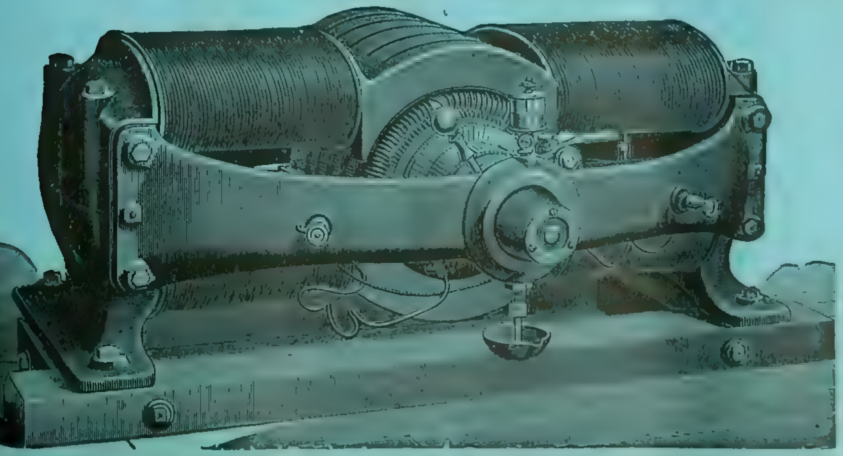

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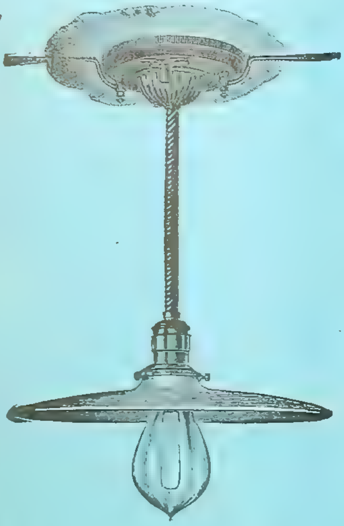

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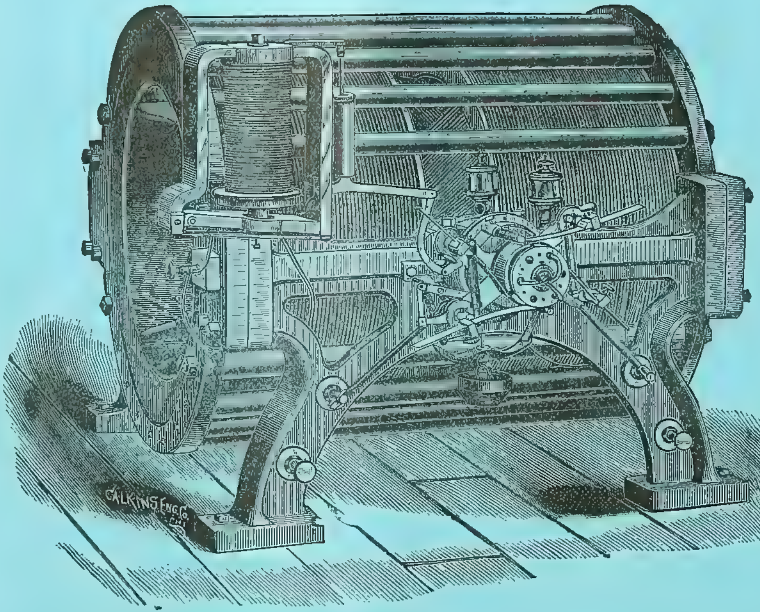

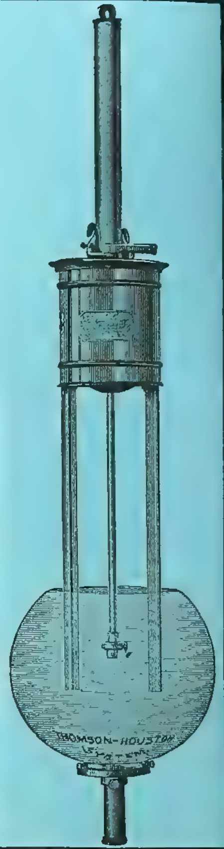

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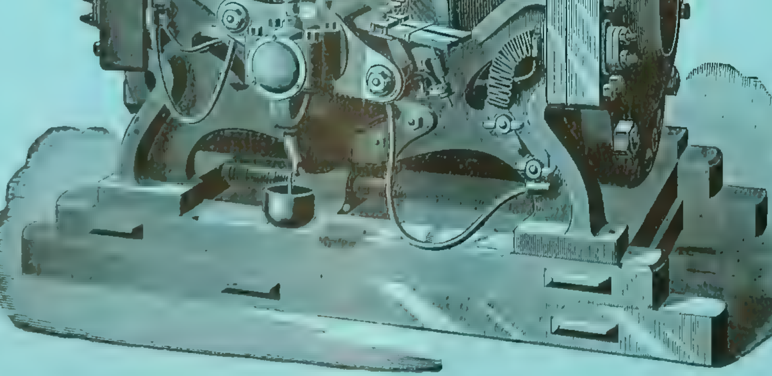

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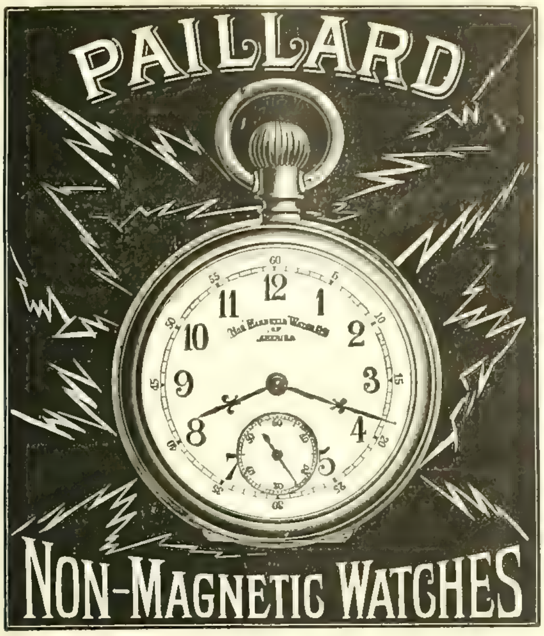

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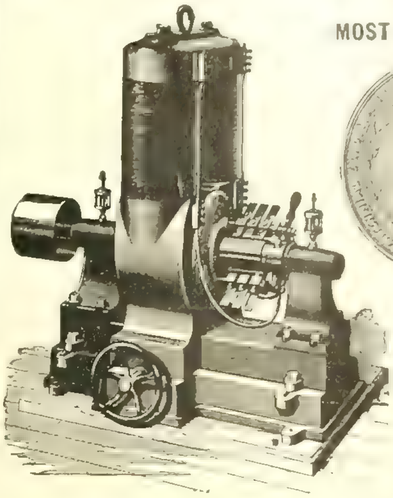

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Buffalo Street R. R., Buffalo, N. Y.
Carbondale & Jermyn R. R., Carbondale, Pa.
Central R. R., Davenport, Ia.
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East Cleveland Street R. R., Cleveland, O.
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Inclined Plane R. R., Cincinnati, Ohio.
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Lafayette Electric R. R., Lafayette, Ind.
Laredo City R. R., Laredo, Texas.
Lindell Ave. R. R., St. Louis, Mo.
Lindell Avenue Street Railway, St. Louis, Mo.
Long Island City and Newton R. R., Long Island City, N. Y.
Loop Extension Wilkesbarre & Suburban R. R., Wilkesbarre, Pa.
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Manchester and [illegible], Va.
Metropolitan R. R., [illegible]
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Northern Division [illegible] Park, Mo.
Omaha Horse R. R., Omaha, Neb.
[illegible] Avenue St. R. R., [illegible]
Passenger R. R., East Harrisburg, Pa.
Passenger R. R. [illegible]
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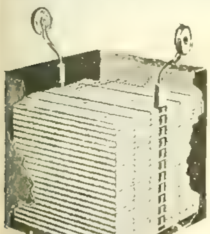

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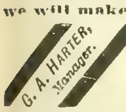

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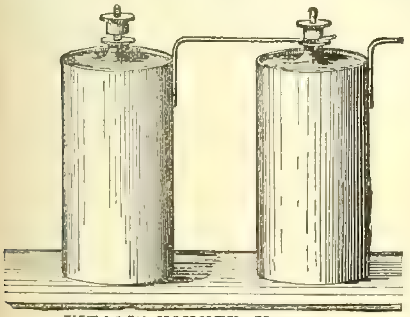

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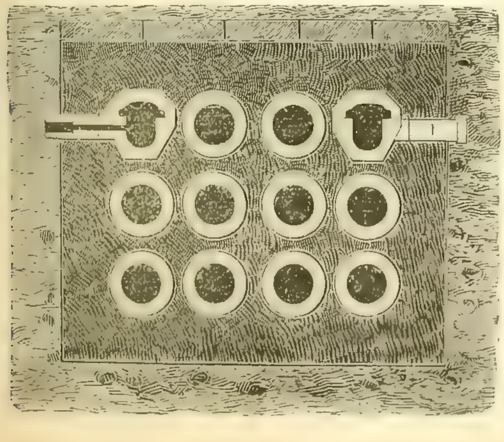

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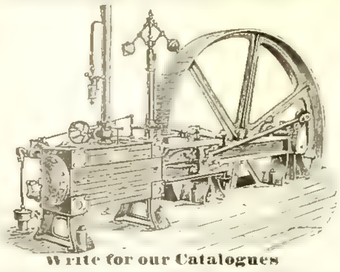

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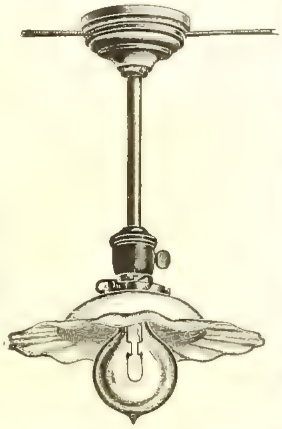

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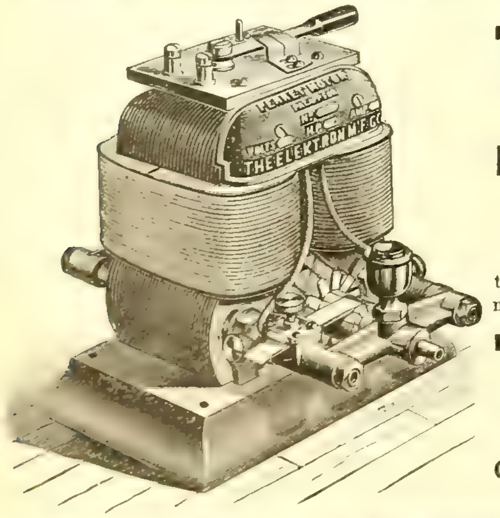

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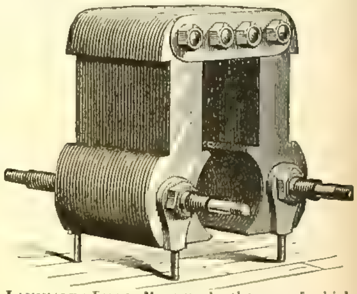

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In the many suits brought by the Edison Company, in the lower courts, against infringers of the Edison patents, the defendants have evaded the *merits* of the controversy, thus tacitly admitting the *fact* of infringement, and have interposed a plea alleging that our patents have been voided by the expiration of patents previously granted in foreign countries.

Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

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Was, or Was Not, Edison the Original Inventor ?

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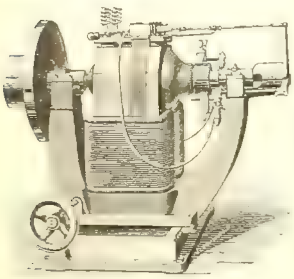

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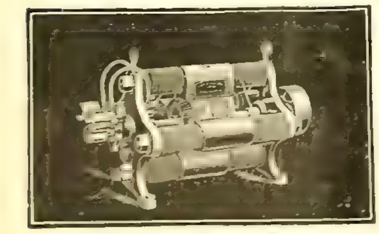

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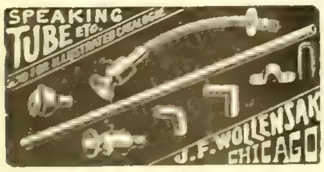

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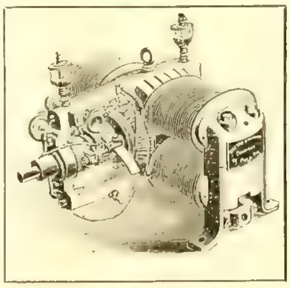

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Vol. IV. CHICAGO, JUNE 8, 1889. No. 23

Toll System at the Chicago Telephone Exchange.

Practical telephony has developed many interesting features during the last few years, and has become one of the most complicated branches of applied electricity. The establishment of long lines, connecting important exchanges, neighboring cities, suburban towns, etc., it may be readily seen, was not unattended by difficulties. These have been overcome, and the suburban service is one of the features of the Chicago exchange. This system not only embraces towns in the immediate vicinity of the city, but the entire district. For instance, the Milwaukee line is well patronized; so are the lines connecting many of the larger points in Illinois. When the toll system was introduced it soon became evident that it would be necessary to place restrictions of some kind upon the service. The company found great difficulty in collecting payment for toll messages, and was accordingly obliged for a time to suffer heavy losses. In large establishments clerks, and often strangers, would call up outside stations, and when the bill for this service was presented to the proprietor of the house, he would object to paying for it. Soon it became apparent that a special contract for toll service would be necessary, and those of the subscribers who desired this privilege entered into a contract with the company, agreeing to become responsible for all toll messages over its line. But here one of the greatest difficulties arose. How was the company to restrict the service to only those who had signed these contracts? Every day applications are made for toll service, and the number is constantly increasing. It would be almost impossible to keep a correct printed list of the names and numbers of the subscribers who were thus entitled as distinguished from those who did not, for obvious reasons, want toll service. It was, therefore, incumbent upon the telephone company to devise some means for keeping an accurate list of subscribers who had made contracts, and for protecting at the same time its own interests. In this predicament a combination switch-board and record was devised, which is unique in its way, and is an excellent illustration of the ingenuity of those who designed it.

The accompanying cuts illustrate the device. In Fig. 1 is given a view of one side of the toll switch-board. It will be noticed that on the table in front of the switch board is a chart marked off into squares, in which, at irregular intervals, are dots. This chart, as it may be called, is an index, in which every telephone in the Chicago exchange is represented, and which at a glance enables the operator to say whether a subscriber is entitled to toll service or not. There are in this chart as many squares as there are hundreds in the numbers of telephones. For instance, if a telephone were numbered 12,600, and although there are not 12,000 telephones, there would be a square for 12,000, and it would be numbered 120.

In Fig. 2 a block, or one of those squares, is illustrated. The cut is about the size of each one of the blocks in this chart. It will be noticed that the number in the left-hand upper corner of the block is 12, indicating that all telephones from 1,200 to 1,300 are represented here. To illustrate the operation of this system, suppose that telephone 1,241 had made a contract for toll service. As soon as the contract is signed a brass pin with a large flat head is inserted in the second row from the left—marked 1—in the units and in the fifth from the top—marked 4 in the tens. Thus the number of a telephone is represented—the figures in the upper left-hand corner representing the hundreds, the figure in the line at the left and opposite the pin standing for the tens, and the figure above in the row marked units—for the last. In the simplicity of this arrangement lies its chief merit. A small boy, after five minutes' training, can operate one of these boards without trouble. Moreover, no time is lost. Suppose, for instance, a subscriber who has not made a contract for toll service calls up the central office and asks to speak with Elgin. The operator at the toll table glances at his chart, and finding the subscriber is not entitled to toll service, notifies him immediately. In case he is entitled, of course, that fact is evident, and the service is given immediately. The Chicago exchange is now operating its toll system on this plan, and is giving much better service under it than before its introduction.

The position of the company in this matter should not be misconstrued. All subscribers [illegible] where their clerks and customers hav[illegible] the instrument. [illegible] where important customers [illegible] to talk with [illegible] subscriber of course pays the bill [illegible] wish to offend his customers by asking [illegible] for the service, though there is no reason [illegible] should not pay. However, the [illegible] growing in favor and is becoming [illegible] most important branches of the business.

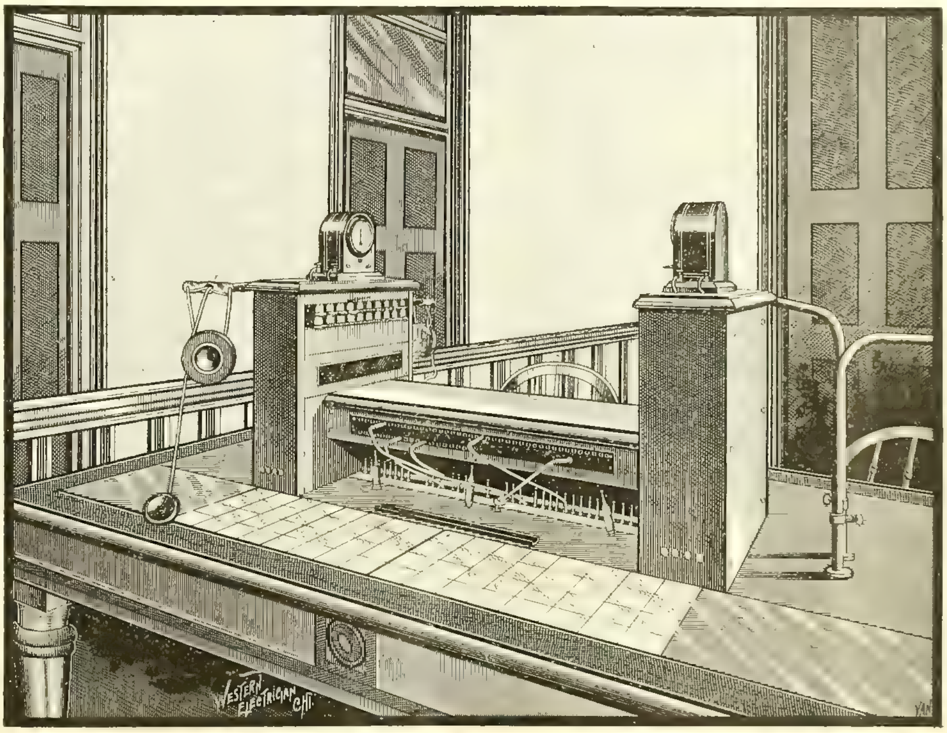


FIG. 1. TOLL BOARD AT THE CHICAGO TELEPHONE EXCHANGE.

St. Louis Electric Light Plant.

Probably few electric light plants in this country have attracted more general attention than that now under process of installation in the city of St. Louis. Not only is it one of the largest installations ever made, but the contractors, in addition to putting up a complete electric light plant, are obliged to build in certain portions of the city a complete subway system for the purpose of carrying their own wires as well as those of the companies providing the incandescent light, and for the accommodation of the city fire alarm and telegraph departments, and other corporations which may desire to use them. The magnitude of the work, and the short time given for its completion, will tax the energies and the facilities of the contractors to the utmost. Upon the opening of the bids in the latter part of the month of February the contract for the arc lighting was awarded to Chas. Sutter, representing the Indianapolis Jenney system. The contract for lighting the public buildings and alleys with incandescent lamps was divided between the Missouri Electric Light & Power company, and C. A. Brown, representing the Western Electric company's system. Mr. Brown's contract was afterward assumed by the Laclede Gas company. Since the award of the contracts much feeling has been aroused between the competing companies, as it had been assumed that the contracts would not be divided, but the company which secured the arc lighting would also get the incandescent lighting as well. However, the Board of Public Works saw fit to divide the contracts. Mr. Sutter at once commenced operations for installing the arc plant, but has met with so many obstacles and delays to his progress that until within a few days very little substantial progress had been made. As all financial arrangements have been completed, the syndicate which now controls the contract

will push the installation to completion as rapidly as possible. Contracts have been made with the Simplex Electrical company of Boston for the entire supply of aerial wire. Cables for the conduits have not yet been decided on. Ground has been secured near the Union depot for the central station, and considerable grading has been done preparatory to putting in the foundation. The location of the central station is most advantageous, as it is on the line of one of the principal railways, and an arrangement will be made so that the coal can be unloaded from the cars into chutes to convey it without handling to [illegible]

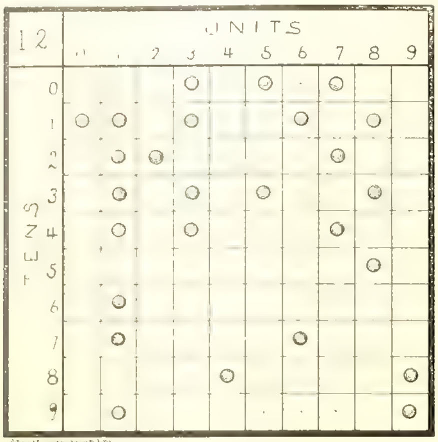
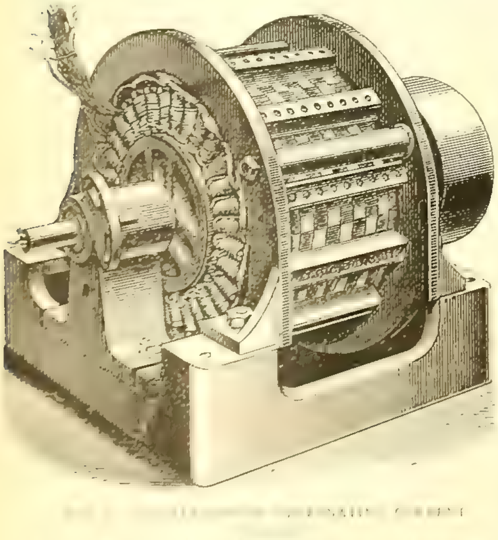


FIG. 2. TOLL BOARD AT THE CHICAGO TELEPHONE EXCHANGE.

This saving in the handling of fuel will effect an immense saving in the cost of the light and enable the contractors to furnish light and power at much less expense than has heretofore been possible by any of the companies now on the ground. The entire capacity of the plant will be 4,000 arc lights of 2,000 candle power each. The present contract with the city calls for between 2,200 and 2,300. In the construction of the lines over 3,000 miles of wire will be used of which twenty miles will be in conduits and the remainder overhead. The Indianapolis Jenney company will supply the dynamos and lamps and all other portions of the electrical outfit. Contracts for the boiler and engines have been let and they will be put in position as soon as the building is ready for them. Work has already been begun on the conduit system which is to extend north and south along Broadway, Fourth, Seventh and Twelfth streets east and west along Chestnut, Olive and Washington avenue, and the work will be pushed day and night until finished. The contractors are expected to complete their work some time



[illegible]

[illegible] tract will become [illegible] Harris has charge of the [illegible] ment between Mr. Sutter and the other companies regarding the furnishing of poles but this matter will be adjusted by the Board of Public Improvements and the work will be pushed forward as rapidly as possible.

It is the intention of the new company to supply both light and power to private consumers and they claim that their great facilities will enable them to furnish light at a much lower cost to the consumer than has ever before been attempted in the city of St. Louis. The company will also run power circuits and gain a very large revenue from the sale of power by this means. Considerable feeling exists between rival companies which has in some cases grown to the extent of threatening injunctions and serving notices upon the Board of Public Works but it is believed that this method of warfare will subside and that as soon as the new company progresses far enough in its operations to warrant a completion of the contract at the time specified, that all these minor matters will be adjusted to the satisfaction of all parties. In the meantime the Laclede Gas company which controls the gas and electric light interest of the entire city of St. Louis with an immense capitalization and a large surplus of money on hand, will not be idle and the citizens can no doubt look forward to some sharp competition in electric light matters all of which will no doubt result in cheaper and better light than they had hoped for. In this regard St. Louis will be the object of envy on the part of other cities, a proof in more ways than one of a shining example of progress and enterprise.

Alternating Dynamo at the Station of a Chicago Company.

One of the latest additions to the already extensive plant of the Chicago Arc Light & Power company is a 1,000-light Thomson-Houston alternating incandescent machine. The demand on the West Side for incandescent lamps had become so great that the company was compelled to take steps toward furnishing the desired light, otherwise certain of the larger consumers would have installed their own private lighting stations.

The installation is worthy of note, for several reasons. It is probably the first alternating dynamo in the city proper installed for commercial station work. The fact that the service is entirely underground will cause the plant to be watched with interest. The potential of the machine is 1,000 volts. Current is conveyed to the converters located in the establishments to be lighted, about one mile from the station on Market street, by two cables for the positive lead and two for the negative. The copper core of each cable is of a carrying capacity equal to a No. 6 wire. In order to test the different kinds of cable, and determine what is best suited for such work, various lengths of each make are spliced together and used as one. The cables are laid in the same manner, and in the same conduits as those for arc service.

All converters have thus far been located within doors, and securely boxed out of reach of any possible meddler. The lamps used are 52 volt 1.04 ampere. The lamps are rented on the contract system, and consequently no meters are in service. It may be mentioned that no ground wire from the converters is used. In many cases the grounding at the converters is a precautionary measure; the Arc Light & Power company, however, prefers to run its system entirely insulated from the earth.

Storage Battery Contract.

The largest contracts in storage batteries ever made were closed on the 21st of May between the North American Phonograph company and the American Electric Motor company of New York on the one hand, and the Pumpelly Storage Battery and Electric Motor company of Chicago on the other hand. The contracts will call for the delivery by the Pumpelly company of over 100,000 cells within a year. The business of the American Electric Motor company now in hand will call for the delivery within that time of not less than 50,000 motors, with a large proportion of which number storage cells are required. The contracts were negotiated by Frank Butterworth and William D. Eaton of Chicago, who have had the matter in hand since the 20th of February last. The Pumpelly cell has been put through a very severe course of tests by the purchasing companies with highly satisfatory results. The contracts give the Pumpelly company the exclusive business of the phonograph and motor companies.

Alternating Current Dynamo.

The accompanying cuts illustrate the latest type of alternating current dynamo, made by the Elwell-Parker company of Wolverhampton, England. It is interesting to note that the type of machine which is here illustrated is now claimed by Ganz & Co. of Budapest, whose latest form of alternating dynamo was shown and described in the WESTERN ELECTRICIAN of May 25th. The following description of the Elwell-Parker dynamo is taken from the London *Electrical Review:* Fig. 1 is the complete machine. Figs. 2 and 3 are two armatures, both

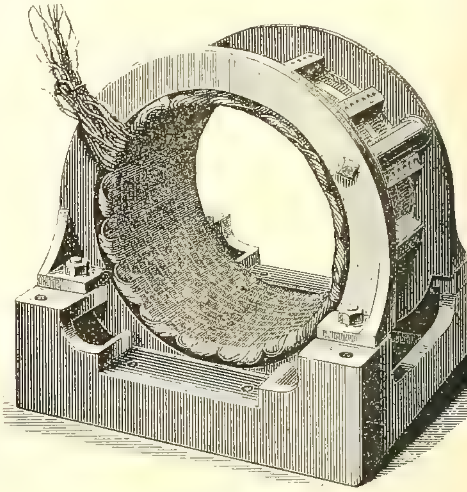


FIG. 2. ELWELL-PARKER ALTERNATING CURRENT DYNAMO.

with iron cores; in one case the whole, and in the other only half of the surface of armature is covered by the conductors. The diameter of the armature is 16 inches, and the length 12 inches. The ends of the wire are brought out together, so that they can be connected in series, parallel, or series parallel as required for experimental purposes. Fig. 4 shows the magnets which are the revolving portion of the machine, the number of poles being 32, and the speed 1,000 revolutions per minute, thus giving 32,000 alternations. In the present form of the machines the section of iron in the armature core has been increased, and the method of insulating and holding the conductors improved. The conductors are, in the first place, insulated from the laminated core, and this is again insulated from the frame of the machine.

Chicago City Plant.

City Electrician Barrett of Chicago has finished his specifications for the extension of the city electric light plant. The bids for mate-

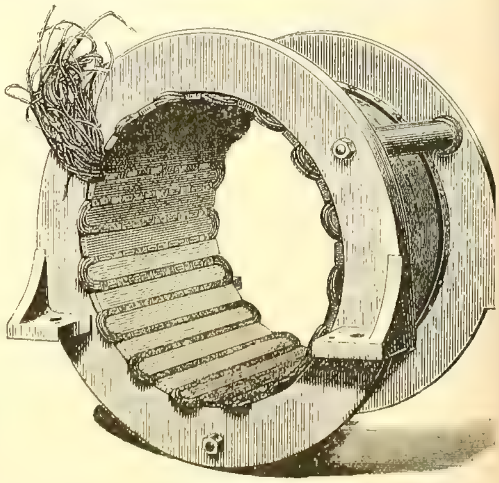


FIG. 3. ELWELL-PARKER ALTERNATING CURRENT DYNAMO.

rial for conduits are now in the possession of the city electrician, and bids for cable will be received until June 17th. The work of excavating for conduits will be commenced immediately, and will be pushed rapidly. Sites for the erection of power houses have been selected, and the work on this part of the system will be commenced at an early day.

Motor Wheel and Axle

The Peckham wheel and axle illustrated in this connection are especially designed for use on electric motor cars. The construction of the wheels is such that metal contact between the wheel-web and the axle is prevented and the entire weight of the axle and its burden rest

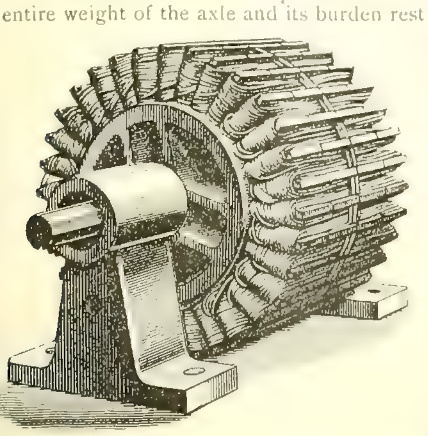


FIG. 4. ELWELL-PARKER ALTERNATING CURRENT DYNAMO.

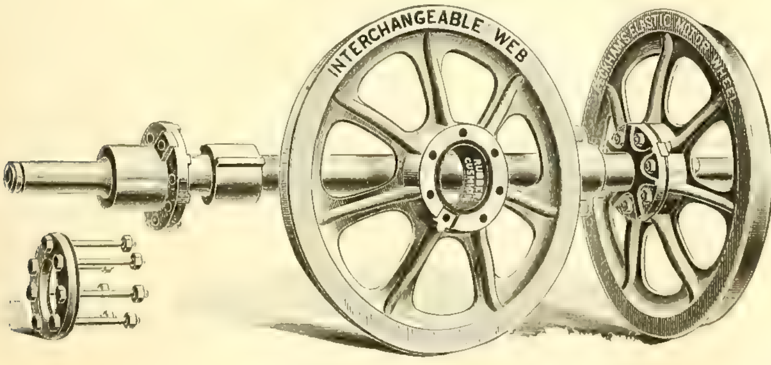
upon and are supported by the rubber cushion which is inserted in the eye of the wheel between the web and the hub. In supporting in this way the entire weight of the load the rubber cushion relieves the axle and motors resting upon them of jars and concussions and crystallization is prevented, less noise produced, and a car rides more easily.

The hub of the wheel is made of steel, and forced by hydraulic pressure upon the axle where it remains until the axle is broken or worn out. The web portion of the wheel is made of best charcoal iron, and secured upon the wheel-hub by bolts which can be easily removed when the web is worn out and a new one placed upon the hub at any car stable, and by an ordinary workman.

The wheel-hub is slightly tapered to correspond with the taper of the rubber cushion which fits snugly into the web, and is secured in place between the web aud the hub by malleable iron front-plates. All parts of the wheel are made to templets so that they are strictly interchangeable.

The axle shown in connection with the wheel is also especially designed for motors. It is constructed with an enlarged bearing for the split-gears in general use on motor cars so that the key-seat for the key used to prevent the split-gear from turning upon the axle, is cut into the enlarged bearing instead of in the axle proper; and while giving an increased bearing for the gear bearing also affords a shoulder for the motor bearing to keep it in place. The axle is also provided at the opposite end with a screw-threaded adjustable collar which can be moved at will and the motor bearings kept in their proper place and all lost motion properly adjusted.

The Peckham Street Car Wheel & Axle



PECKHAM MOTOR WHEEL AND AXLE.

company, 239 Broadway, N. Y., is the manufacturer of these wheels and axles.

Chicago Telephone Company.

The Chicago Telephone company suffered last week owing to the rain. The force of repairers and inspectors was kept at work night and day, and thus the cause for complaint on the part of subscribers was materially lessened.

Cooling Dynamos by Air Blast.

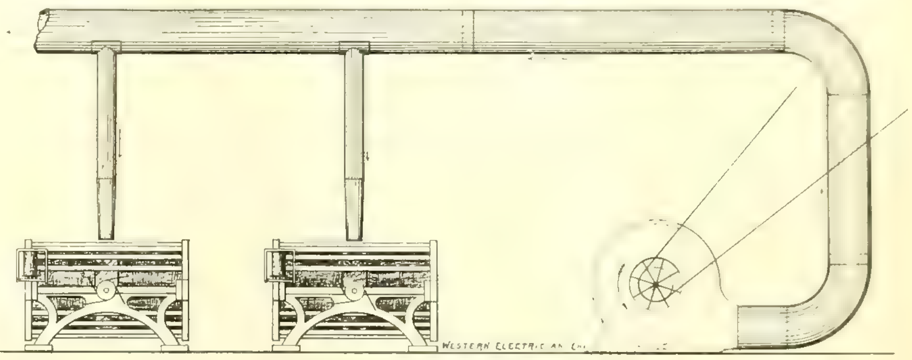
With whatever care and pains an electric light plant may have been installed at the start, even if the best machinery has been adopted and put in place by skilled men, there is always some difficulty, some trouble, which time and circumstances will develop. A bold and novel method of overcoming one of those innumerable small difficulties which beset the electric light superintendent, is illustrated herewith. Dynamos, in some instances, have to be located and run in rooms where even the best efforts at ventilation will not prevent the temperature, during the hot summer months, from rising, at times, to an excessive degree. In such cases machines which ordinarily run perfectly cool often become dangerously heated throughout.

The cut shows a method of forcing a blast of air in and around the body of the machines to cool them. A Sturtevant pressure blower delivers air at a pressure of about four ounces to the square inch to an overhead main supply pipe. Branches from the main pipe run to each dynamo, and a constant blast of comparatively cool, fresh air is thus kept upon the machines. This system of cooling dynamos has been applied at the station of the Chicago Arc Light & Power company, and is, it is stated, very effective.

The Book Table

ELECTRICAL RULES, TABLES AND FORMULÆ. By Andrew Jamieson, C. E. F. R. S. E. 64 pp. Published by the Industrial Publication Company, New York. 75c.

This is a handy little volume which contains



COOLING DYNAMOS BY AIR BLAST.

in compact form a large number of working tables and formulæ. The work contains practical directions for all the calculations and tests, and all the apparatus which is described is fully illustrated. After treating of electrical measurements, the author devotes considerable space to conductors, insulation, submarine cables, land lines, and electric lighting and transmission of power.

ELECTRICITY IN FACIAL BLEMISHES. By P. S. Hayes, M. D. 118 pp. Published by W. T. Keener, Chicago.

In this work Dr. Hayes describes somewhat minutely the methods he has adopted to remove superfluous hair by electrolytic action. The book is written clearly and the directions are minute, so that any physician may readily follow the author's plan. The book is, of course, intended for the use of physicians.

HISTORY OF THE TRANSFORMER. By F. Uppenborn. Translated from the German. Published by E. & F. N. Spon, London and New York. 60 pp. 50c.

This little book when it was first published in [illegible] companies operating electric light plants.

New York Board of Electrical Control

The first [illegible] brought [illegible] Control at the meeting of the 28th [illegible] electrical expert according to which [illegible] miles of wire [illegible] been removed [illegible] city since Jan. 1 [illegible]. The report [illegible] the East River Electric Light company [illegible] of poles in [illegible] avenue the [illegible] placed on poles on one side only of these streets. The Western Union company was ordered [illegible] a large number of streets where there are [illegible] placed on a single line. Commissioner Gibbens said that the Western Union company had not [illegible] diligence in taking down its wires. It had certainly taken down a few wires along the line of the elevated railroad, but the city had done the rest. Its wires on Tenth avenue were in many cases dead wires. Mr. H[illegible], superintendent of the Western Union company, questioned this statement He said the line of wires on Tenth avenue was in actual use by the Pennsylvania Railroad company, the New York Central and Erie railroads, and also connected with the sixteen offices of the company on the west side of the city. He thought it unfair for the board to ask the company to cut these connections, and then make them wait until permission had been given to make the connections again. On Mr. Cutler, vice-president of the Metropolitan Telegraph & Telephone company, saying that his company would carry the wires of other companies on its poles where they were strong enough, Mr. Hennstone expressed his willingness to adopt that arrangement, wherever possible. Mayor Grant said he should try to remove all the difficulties he could in order to assist the companies to operate their lines, but what he insisted on was that they must go into the subways where there are subways. Eventually the matter was laid over so that a formal proposition to remove their pole line in Ninth avenue and [illegible] the transference of their wires to the structure of the elevated road, shall be presented to the board by the Western Union company. A number of permits were granted for telephone connections, many persons having changed their places of business or residence It was decided to request the corporation counsel to act as counsel for the board. The meeting then adjourned to 11 o'clock on the following day, when a large number of applications was presented from electric light companies for permission to string wires in parts of the city where there are no subways. The mayor said the board should not be too ready to grant these, as he had now no doubt whatever that all the companies had violated the law. Mr. Jackson, the president of the [illegible] States Illuminating company, said he would [illegible] statement. The offence that his company was charged with, that of putting up new lights without permission, had been committed without any intention to break the law. The lamps were market lamps which had been put on [illegible] circuits, and it was not supposed that a new permit would be required. The mayor was not disposed [illegible] contemplated action against the company, [illegible] matter over with the commissioners, [illegible] do so, principally on the ground that he did not want to incommode the public, and apparently [illegible] stand made by the commissioners in [illegible]

Several permits were then granted [illegible] the [illegible] Illuminating, the Manhattan, the East River, the [illegible] North New York, the Mount Morris, [illegible] place arc lights, to the number of [illegible] of the city. There appears to be some [illegible] the rates of the Subway Construction company [illegible] not present [illegible] to the companies [illegible]

[illegible] understood the charges [illegible] paid for in five years. The mayor said he had heard no definite complaint on the subject but he was quite ready to listen to any one who had any remarks to make. Commissioner Hess said the law gave the board power to regulate the charges of the [illegible] any attempt on the part of the [illegible] immediate attention of the board.

[illegible] United States company had increased the price for electric lights where the wires were in the subway, but Mr. Jackson denied this Mr Foster, of the [illegible] that if the proposed adjustment by the board of the construction company's charges were made, his company wou'd reduce its rates in the subway district to the same standard as charged in other patts of the city

[illegible] thanking the New York Central and Hudson River Railroad company for allowing the fire department to string wires in the Fourth avenue tunnel.

The opinion of the corporation counsel was solicited as to whether or not the board can exercise any control over electric lighting in the parks and public places. Corporation Counsel [illegible] stated that the laws relating to parks were passed before the subway laws were passed, and the latter are not intended to repeal the park laws. The board held a different view, and so referred the matter to Corporation Counsel Clark for his opinion

The Brush Electric Light company wrote to Mayor [illegible] as follows "Your board having accepted our new cables, we are now prepared to light Madison Square, a good part of Broadway, and possibly lower Fifth avenue" The board adjourned subject to the call of the chair

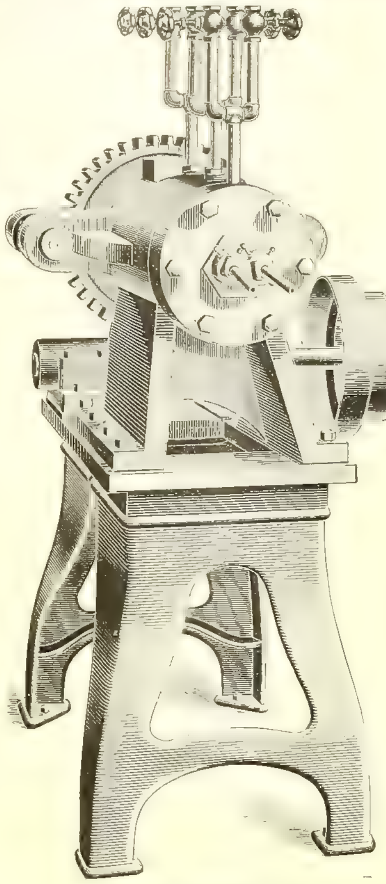
Double Girder Rail.

The White double girder street railway rail is shown in the accompanying cuts. The general form is shown in Fig. 1. The rail is made by rolling integral with the top or tread of the rail two pendent sides or girders, thus giving greater strength to the rail where most needed than the ordinary girder rails having a central vertical rib. The top or wearing part of this rail may be made as shown by full or dotted lines, but by making it as shown by full lines more wearing surface can be obtained on the head of the rail before the flange of the wheel touches the bottom of the groove, and carriages can easily pass over or out of this rail, and the groove cannot become clogged as the flange of the wheels acts as a wedge as it passes along and forces any stones or dirt out of the way. Fig. 2 shows the rail secured on a chair by a bolt passing through the pendent sides of the rail and through the upper ends of the chair. The chairs are placed at suitable intervals along the rails between the joints, and a similar chair of sufficient length is used at the joints of the rails for connecting them together, thus making a substantial and practical joint. These are secured to wooden sleepers by lag screws, as shown, but the wooden sleepers may be dispensed with by enlarging the base of the chairs sufficient to give them a solid [illegible] to gauge. The rail is [illegible]

[illegible]

Tubing Machine.

The Clark tubing machine is shown in the accompanying cut. It is employed especially in covering telephone and electrical wires generally with rubber or with any insulating compound. All sizes of wire smaller than number 10 B & S gauge are covered two at a time



CLARK TUBING MACHINE.

The length of cylinder and size of bore are such as to secure a perfectly even working and heating of stock before it reaches the dies. The heads are the same size of bore, and cores are fitted to them. When one size is changed for another or when the machine is cleaned the unscrewing of the one bolt head removes everything without trouble or delay. All the heads have nipples that will interchange, varying in size by 1 of an inch so that the thickness of the walls of the tube can be made as heavy or light as desired; the heads have cores from [illegible] inch to [illegible] inch diameter, varying by sixteenths; the nipples from [illegible] inch, varying by sixty-fourths. The cylinder has three separate steam [illegible] around the cylinder, [illegible] heat at all points. The [illegible] market by E. W. Clark, Hartford, Conn.

New York Electric Club.

Erastus Wiman addressed the New York Electric club last week on the folly of contention and constant litigation. He advised a combination of interests. "I went into a bank the other day to get a little money," said Mr. Wiman, "and was asked for my securities. I offered electrical securities, and they were refused. 'They are no good,' said the president. 'The patents are all wrong, and there is such strong competition, and moreover you never can tell when another new mayor is coming along with an axe to cut down your poles' Competition has been described as the life of trade, but it is the death of profit, and in no business is there stronger competition than in the electrical. If the companies were properly consolidated these electrical securities would be the best kind of investments. Competitive telegraphy is not a success."

Mountain Electric Railway.

One of the most interesting achievements in modern engineering is the electric mountain railway recently opened at the Burgenstock, near Lucerne. The rails describe one grand curve formed upon an angle of 112 degrees, and the system is such that the journey is made as steadily and smoothly as upon any of the straight furnicular lines The Burgenstock is almost perpendicular—from the shore of Lake Lucerne to the Burgenstock is 1,330 feet, and it is 2,860 feet above the level of the sea The total length of the line is 938 metres, and it commences with a gradient of 32 per cent. which is increased to 58 per cent. after the first 400 metres, this being retained for the rest of the journey. A single pair of rails is used throughout, and the motive power, electricity, is generated by two dynamos, each of twenty-five-horse power, which are worked by a water wheel of nominally 125-horse power, erected upon the River Aar at its mouth at Buochs, three miles away, the electric current being conducted by means of insulated copper wires. The loss in transmission is estimated at 25 per cent.

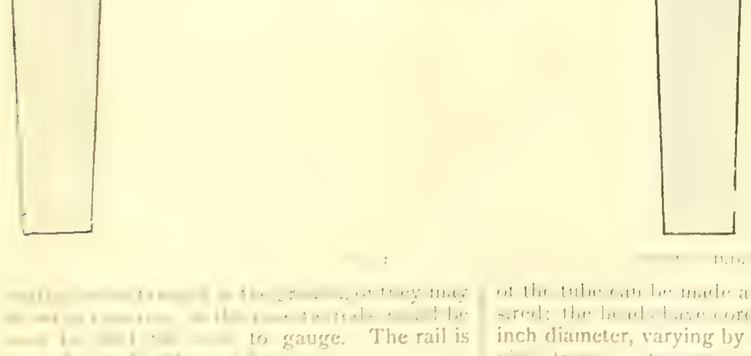
Electric Lighting in Canada.

At a recent meeting of the city council of Three Rivers, Canada, A. J. Corriveau of the Royal Electric company, and Geo. McDougall, on behalf of a local syndicate, offered to supply the city with electric power to operate waterworks, to furnish motive power for factories or other purposes, and also to supply electric lights, the necessary arc lights for street lighting and all the incandescent lights needed for the private lighting of stores, residences, etc —2,000 to 3,000 lights or more if wanted. A magnificent water power, of the capacity of 10,000 to 15,000 horse power, situated on the St. Maurice River, 17 miles from the city, would be utilized for that purpose. The alternating system will be used

The Phonograph.

Speaking of his work on the phonograph, Thomas A Edison said the other day: "At the present time the phonograph is occupying my time. I have been improving it, and it is more perfect to-day than ever. In speaking into the phonograph it was soon found that the sibilants were not recorded. For instance, if I were to say 'species' the 'sp' sound would be lost. Well, I have about solved the problem now, and the sound of 's' is inscribed with the other letters. I run the phonograph or graphophone in three ways—with a treadle, a battery, or from the ordinary incandescent circuit. Business people can have their choice. I shouldn't want to be bothered with a treadle, and I think the best plan is to use the electric light circuit, since wires are now so commonly distributed. The battery is made to last for a month, three months, or six months without being renewed. Let every man take his choice. I am making the three kinds."

A Cincinnati paper of May 30th says. "The new electric street railway beginning at the top of the Main street incline successfully ran its first car yesterday. The cars will be running regularly within ten days."



[illegible]

[illegible] RAIL.

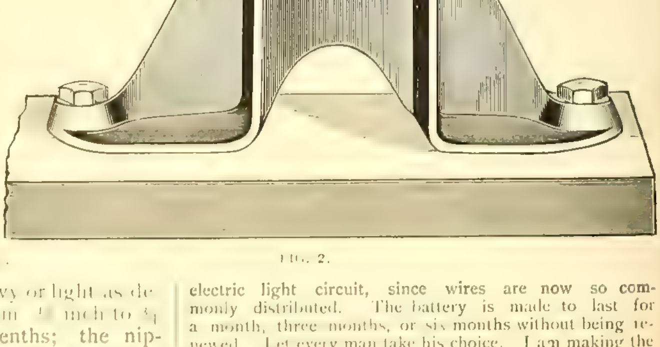
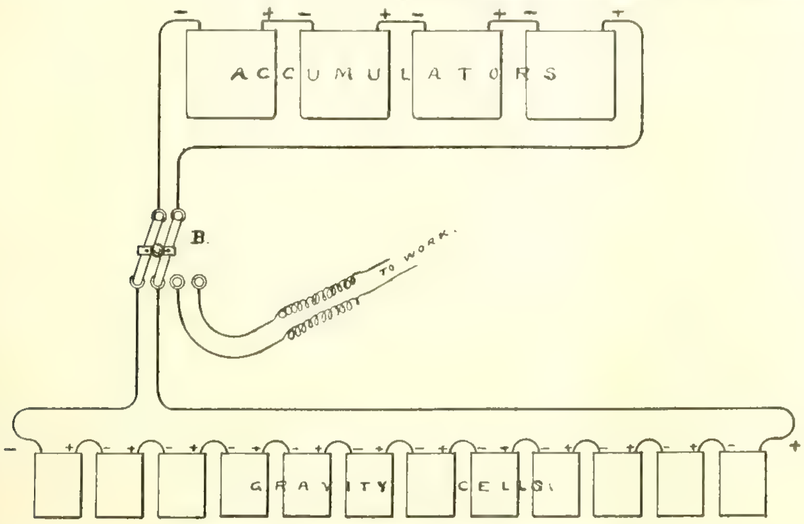


FIG. 2.

Charging Accumulators by Primary Batteries.

Doubtless there are at the present time, hidden away in some of the more obscure shops and laboratories, many curious and novel electrical devices which, if brought to light and properly applied, would prove most useful. Not long since the writer had occasion to visit a small electrical repair shop in Chicago, and while there, through the courtesy of E. E. Flora, the electrician in charge, was shown the latter's arrangement for furnishing current to a small motor from storage batteries which were kept charged by the current from primary batteries.



CHARGING ACCUMULATORS BY PRIMARY BATTERIES.

While this idea of charging accumulators by means of the primary battery may, perhaps, not be entirely novel, it is so rarely put into practice that a description of such a plant may prove interesting.

Reference to the accompanying cut will enable the reader to understand readily the whole arrangement. Twelve—more would be better—ordinary gravity or sulphate of copper batteries are arranged in series, so as to give sufficient e. m. f. for charging, say, ten volts. These batteries are connected to the series of four accumulators, which when charged, have a total e. m. f. of, say, eight volts, in such a manner as shown, *i. e.*, the + terminal of the series of gravity cells connects with the positive plates of the accumulators, and the — terminal with the negative plates. The number of cells of battery to be used in any particular case depends, of course, upon the work to be done. In any event, however, the arrangement should be such that the e. m. f. at the terminals of the primary series should always be in excess of that at the binding posts of the set of accumulators. This is necessary not only to charge but to prevent the storage cells from discharging through the gravity batteries. A double-pole switch, *B*, is provided, so that it is but the work of a moment to disconnect the accumulators, and apply them to their work.

Such a plant as this, it is understood, is now in daily service at Dr. Whitfield's office in Evanston, Ill., and furnishes current to a motor on his dental engine, and also to other electrical instruments used, from time to time, in his practice.

Where work is intermittent and light, as in the case of dentists, etc., there seems to be no reason why such a scheme as this should not be perfectly practicable, and prove in many cases most useful. The cells might be kept out of the way, so as to avoid inconvenience from any possible dirt or fumes which might arise from their presence in the room, and the wires be led to a small and neat switch-board where, when the current was required, the simple movement of a button would be all that was necessary.

The gravity battery, from the fact of its working best when on a "closed circuit," or in other words, when kept constantly at work, is well suited for this work, and consequently may be kept at work through the day and night whenever the accumulators are not in service. In this way the comparatively feeble current of the primary battery may, so to speak, be stored and applied in a greater quantity just when desired.

Electric Tramway at Factories.

A need of better facilities for the handling of supplies and products in large manufacturing establishments has led to the adoption of the electric motor as shown in the accompanying illustration. As a great number of the large mills are now supplied with electric lighting systems, this equipment becomes an easy matter, and it is safe to predict that before long the electric tramway will come to be considered a necessary feature of a mill plant. The Thomson-Houston Electric company has equipped several tramways of this kind, and has contracted for others, which will soon be put in operation. The tramway car at the company's works in Lynn is used for carrying heavy machinery to different parts of the factory, and its use permits the handling of apparatus with much greater ease, in less time, and with less labor than could possibly be accomplished by any other method. The car is equipped with two 3-horse power motors, and easily carries up a grade of 15 per cent. a load of five tons, while from eight to ten tons can be carried on a level. The motor receives its current through

ELECTRIC TRAMWAY AT FACTORIES.

Louisville, Ky., Electric Railway.

[illegible] days to have the line working smoothly. The [illegible] every way better than any other, not excepting the cable, for a city of such easy grades as [illegible] safety the electric cars are vastly superior to any others. The suburban lines will eventually be included, and this will solve the residence problem that is now becoming a serious one."

Electrical Course at Princeton.

Candidates for the degree of electrical engineer from Princeton will be required to take a two years' course after passing a satisfactory examination in the following subjects: Mathematics, including trigonometry, analytical geometry, differential and integral calculus, physics [illegible] course at this college (see Anthony & Brackett's text-book.) Elements of Chemistry. Ability to read French and German is desirable. Students who have pursued the course in the academic department of the college, through the junior years, and have taken the elective course in mathematics, and also students who have completed the junior year in the John C. Green School of Science will be admitted to this course. The course will be [illegible] trated both as respects electrical theory and the applications of electricity in the industries, such as electrical [illegible] transfer of energy, electro-chemistry [illegible] etc. Examinations for admissions will be held [illegible] and 21st at Princeton and at other points [illegible] tions are usually held.

The California hotel and theater at San [illegible] supplied with two of the Root boilers [illegible] capacity which will furnish power [illegible] with which the [illegible] will be lighted [illegible] as for running the elevators. They [illegible] heating purposes.

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DEPARTMENTS.

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A [illegible] of an alternating equipment lately installed for incandescent service in the largest electric light station in Chicago is given in this issue. The installation is a most interesting one, as it is probably the first plant of its kind for central station work in the city. In addition to this, the fact that the service is underground serves to make the installation one which will attract unusual attention.

[illegible] electric motor car [illegible] wagon on which [illegible] intended for a memorial [illegible] on the car track [illegible] How to get [illegible] puzzle. The [illegible]

[illegible] out-of-town service [illegible] e to all [illegible] to electricians in general and all who endeavor to keep abreast of the times in the development of electrical science.

AN inscription has been placed over the American section in the machinery hall in the Paris exposition which, though brief, is full of interest. It states that the United States possesses steam engines of 450,000-horse power, the power of which is transformed into electrical energy; and that, apart from transmission of power, this energy is used to supply current nightly to 2,000,000 incandescent lamps and 250,000 arc lamps.

A DESCRIPTION of an electric tram car, used in transferring heavy machinery from one part of a factory to another, is given in another column. The installation is of great interest to owners of factories generally, as the ease with which it is operated is so manifest. Large mills are as a rule lighted by electric light, and with a supply of current at hand there is no apparent reason why electric mill tramways should not become a necessary part of a mill equipment.

THERE has been an unusually large number of fatal accidents caused by lightning during the spring. The New York *Sun* has called special attention to the matter, and says that electricians should bestow on the question of protection from lightning a much greater degree of attention than they are at present according to it. It may be true, as the *Sun* hints, that American electricians of this country are so busily engaged in solving the many problems connected with electric lighting and transmission of power, that the subject of lightning strokes has received insufficient attention.

WHEN the city electric light plant was established in Chicago, it was argued that the underground system would receive its test during the rainy season in the spring. The spring has come, with the attending showers—showers of three days' duration, when it appeared as if the floodgates of heaven had opened, and the underground system withstood it all. City Electrician Barrett was naturally in high glee. "That's a test, and a good one," he said, "and there is not a complaint to be made. The lights are all running, everything is working like clock work, and I couldn't have a more satisfactory test from my standpoint if I had arranged everything for myself. Last week we had drenching rains of long duration, and there is not a particle of trouble." Another feature of the underground system was found aptly illustrated in this storm. Chicago was the center of a terrible windstorm which lasted two nights and a day. The wires of course were not affected.

ALDERMEN on a junket in search of information, form a curious party. A case in point comes from Sioux City, Ia. Committeemen, representing the council of that city, visited Chicago recently, ostensibly for the purpose of examining the several systems of electric lighting in operation, with a view of securing information which would guide them in selecting a system to recommend to their aldermanic brethren. On the return of the party to Sioux City it is evident the aldermen were closely questioned by their constituents, for a local paper publishes a detailed account of their visit to the metropolis of the West, and the objects that attracted their attention. The mornings were to a great extent devoted to rest. In the afternoon, the aldermen frankly admit, they attended ball games, drove on the boulevard and indulged in lake excursions, and in the evening they visited the theaters. Where did they secure information on electric lighting? That came in incidentally at such odd moments as could be spared. Nearly every week delegations from city councils of enterprising Western towns and also many important Eastern [illegible] Chicago for information about electric lighting and underground wires. But the delegation from Sioux City was an exception to the [illegible] endeavoring, when they reached home, to impress their constituents with the idea that they had labored unremittingly in [illegible] the trip, they honestly announced that they had seen the sights and enjoyed the pleasure of a trip to a big city—that they had a good time, and enjoyed it. Their frankness entitles them to respect and distinction.

THE bill passed by the Illinois legislature permitting companies operating dummy or horse car roads to substitute cable or electric systems for existing methods of propulsion has been widely commented upon. The measure has not received favorable criticism at the hands of the daily press for the most part. The objection which is most strenuously urged is that it gives the companies too much latitude; that it makes them too independent. As it was stated last week, the bill will probably amount to little, and the objection to it seems to be of little importance. As a matter of fact, the people are not consulted when a company desires to change its motive power; the city council is usually asked to grant the privilege. Common councils, realizing the benefits which accrue to a city from rapid transit, are usually not slow to grant a permission to make the change. Practically, therefore, the new measure signifies very little beyond the implied indorsement of electric railways as opposed to dummy or horse car roads.

IN the preliminary examination of jurors in a murder trial, which is in progress in Brooklyn, the question arose whether a decided objection to the execution of a capital sentence by the application of electricity constituted a valid ground for disqualification. The presiding judge decided in the affirmative. The subject is presented in the New York letter this week, and several comments of prominent lawyers are quoted. The question involves a very nice distinction. It is usually stated by a presiding judge at the outset of a capital case that the jury is not to be influenced by the consequences which may result from its finding, except to bring to bear upon the case a more careful scrutiny than would naturally be given to a less serious proceeding. If such an instruction were given, and if the juror expressed no conscientious scruple against the principle of inflicting the death penalty, it would be hard to see how disqualification would follow even if execution by electricity was not approved. On the other hand, if the opposition to the execution of the death penalty was so strong that the juror would hesitate to recommend it, even if he thought the prisoner guilty of murder in the first degree, it can readily be seen that practically the juror would be incompetent to serve. It is a nice question, and one which the lawyers will enjoy.

THE residents of Cleveland are anxious to have a number of new electric railways. Last week the citizens held several mass meetings in furtherance of their project for the extension of motor roads. It is interesting to note the enthusiasm which is manifested, inasmuch as the electric system has already been given a fair trial in the city. One of the leading business men in a public address declared that he considered the talk about the wires disfiguring the street to be the veriest nonsense. When he thought of the hundreds of wires that were stretched over the streets for the accommodation of the few people who used telephones, and heard the hue and cry raised at the suggestion of putting up two more wires for the benefit of the thousands who rode on the cars, he was disgusted. The press of the city is zealous in the cause of the advocates of electric railways, and the columns of the papers are filled with short items, of which the following are fair samples: "The Chicago State street cable road runs at a speed of ten and one-half miles per hour from the loop to Twenty-second street; twelve miles per hour from Twenty-second to Thirty-ninth street, and above Thirty-ninth street at fourteen miles per hour. An electric car can be run at the same speed, and with much less danger." "The people of East Cleveland believe 'that the public convenience of the city of Cleveland requires and demands that the electric motor system be extended to the public square.'" The case is mentioned simply to illustrate the success which electric railways have already attained, and the feeling with which business men regard them.

Annual Meeting of the American Institute of Electrical Engineers.

Among the papers read at the last meeting of the American Institute of Electrical Engineers were the following:

ELECTRIC MOTOR REGULATION.

BY FRANCIS B. CROCKER.

Although this subject is one of great scientific and practical interest, it has not been very frequently or very fully treated up to the present time. Of course, motor regulation is very similar to dynamo regulation, but it is by no means identical with it, and it deserves and requires separate treatment.

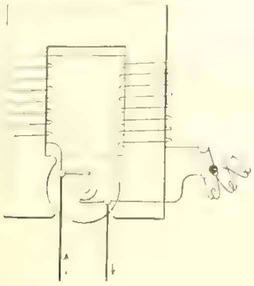


FIG. 1.—Shunt Motor with Variable Resistance in Field Circuit.

I do not think it is much exaggeration to say that at the present time there is no subject more generally important to electrical engineers than motor regulation. Considering this fact, it is certainly remarkable that the literature of the subject is so limited. We find stray articles in electrical periodicals, rarely more than a description of one particular invention, and in electrical books, regulation is referred to incidentally in connection with descriptions of the various motors. There is also, to be sure, usually one short chapter devoted to this subject, but it is apt to be either very general, merely mentioning a few regulating devices, or else it is confined to the mathematical analysis of some one particular method.

Motor regulation is a subject which is somewhat confusing, and requires therefore accurate definition of the quantities and conditions which enter into it. One case is, at first sight, very similar to another, and yet, more careful consideration will show, very likely, that it is exactly opposite. Take for example the two commonest and most important cases, viz., the constant potential and the constant current motors. The conditions of the two cases are precisely opposite, and the solution of the problem is, naturally, entirely different. To maintain a motor at a constant speed with a variable load, on a constant potential circuit, which is the case of the ordinary shunt motor on the regular 110 volt incandescent circuit, is a very easy problem—in fact, it solves itself. A simple shunt-wound motor will run at a practically constant speed on a constant potential circuit, even if the load varies from zero up to the full capacity of the motor. Now this form of motor is exactly what we would use, even if we did not care to have it regulate. It is customary, to be sure, where very close regulation is required, to wind constant potential motors differentially, *i. e.*, with series as well as shunt coils, but this is not essential for ordinary work.

The case of the constant current motor, on the other hand, is as difficult as the first is easy. It seems as if it

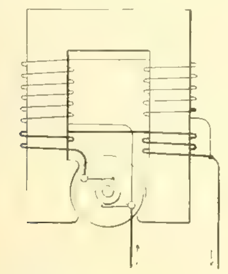


FIG. 2.—Differential Motor. Self-Regulating.

had to bear the burden of both. Neither a shunt-wound nor a series-wound nor a compound-wound motor can be used practically on a constant current circuit to maintain a constant speed with variable load. The ordinary series-wound motor, which is the natural and common form for the constant current motor, will race away when the load is taken off, and increase in speed until it tears apart or strains the armature and ruins the machine. We require some special and very effective device to accomplish the regulation in this constant current case, and it seems to happen that almost every device that has been thought of has serious difficulties and complications. The ordinary, and what would seem to be the best solution of this problem is to vary the magnetic effect of the field upon the armature directly in proportion to variations in the load. This is effected by cutting out the field coils, and by other methods which will be described later. But there are difficulties with almost all these plans.

These two cases, which, as already stated, are the commonest and most important which occur, and yet which are so very different in almost every respect, give a general idea of what we have to deal with in motor regulation.

In order to fix and hold the rather numerous quantities and conditions that present themselves in connection with motor [illegible]

TABLE I.

[illegible]

1. Hand regulation.
   Usually employed for varying the speed.
2. Automatic regulation.
   Usually employed for maintaining constant speed; effected by
   Centrifugal governors.
   Dynamometric governors.
   Electro-magnetic devices.

[illegible]

1. Shunt winding. Fig. 1.
2. Differential winding. Fig. 2.
   Varying external resistance in series with
3. Armature.
4. Field. Fig. 1.
5. Both armature and field.
   Varying internal resistance of
6. Armature.
7. Field by cutting out coils in series. Fig. 3.
8. Field by cutting out coils in multiple arc. Fig. 4.
9. Field by grouping coils in series or multiple arc.
10. Both armature and field. Fig. 5.
    Varying shunt in multiple arc with
11. Armature.
12. Field.
13. Both armature and field. Fig. 6.

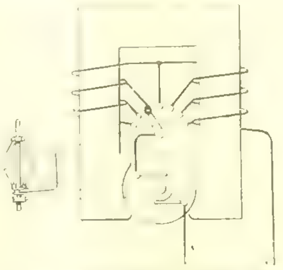


FIG. 3.—Series Motor with Switch for Cutting Out Coils in Series.

14. Varying current in separately excited field.
15. Shunting field magnetism. Fig. 7.
16. Short circuiting field magnetism. Fig. 8.
    Varying commutation by
17. Shifting brushes. Fig. 9.
18. Shifting commutator.
19. Shifting magnetic resultant.
20. Moving pole pieces away from armature. Fig. 10.
21. Moving armature away from pole pieces. Fig. 11.

TABLE II.

LIST OF POSSIBLE CASES WITH DIRECT CURRENTS.

P = Difference of potential in volts at terminals of motor.
C = Current in amperes supplied to motor.
S = Speed of armature in revolutions per minute.
L = Load or torque in lbs. at one foot radius.

Any of these four quantities may be either constant or variable, making the following combinations:

Case	Constant.	Variable.	Example.
1	P	C S L	Series wound motor with variable load on const. pot. cir.
2.	P S	C L	Shunt or comp. wound motor with variable load on con. pot cir.
3	P L	C S	Shunt motor with con. load, and var. field resist. on con pot. cir.
4.	P S L	C	Not practical.
5.	P C	S L	Not likely to occur.
6	P C S	L	Not practical.
7.	P C L	S	Not practical.
8.	L [illegible]	[illegible]	Shunt motor with constant load on constant potential circuit.
[illegible]	[illegible]	[illegible]	Shunt motor with variable load on constant current circuit.
[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	P C	[illegible]
15	L	[illegible]	Motor [illegible] without speed gov. on cir. of var. pot and cur.
16	[illegible]	P [illegible] L	Motor [illegible] without speed gov. on [illegible]

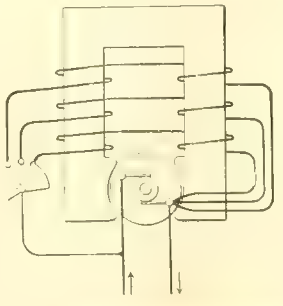
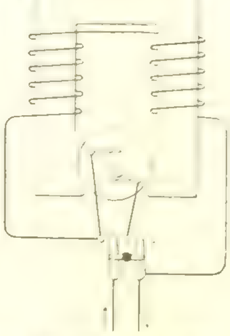


FIG. 4.—Shunt Motor with Switch for Cutting out Field Coils in Multiple Arc.



[illegible]

In Table I, motor regulation is divided into hand regulation, which, it happens, is almost always used for varying the speed of a motor, by a hand switch Fig. 1, for example, and automatic regulation, which is almost always used to maintain a constant speed, and which is usually accomplished in one of the three following ways: First, by a centrifugal governor similar to that of the steam engine, operating a switch or other device, Fig. 3; secondly, by a dynamometric governor, *i. e.*, a mechanism through which the load or torque of the motor is transmitted, which may also operate a switch and vary the power of the field by the direct effect of changes in the load; thirdly, by an electro-magnetic device, such as a solenoid, through which the current or a portion of it is passed, which causes the core of the solenoid to move and operate a switch in accordance with variations in the current, Fig. 9.

The table next gives the principal methods used to regulate motors. These consist of different arrangements and combinations of parts to produce different effects or changes in the working of the motor, and they constitute the means which we have to employ to accomplish a certain result in motor regulation. Method 1 is simple shunt winding,

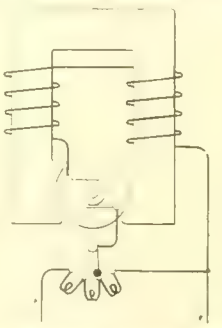


FIG. 9.—Series Motor [illegible] Shunt [illegible]

which consists in exciting the field magnet with a coil having comparatively high resistance in multiple arc with the armature, Fig. 1. This maintains a practically constant speed with varying load on a constant potential circuit, and does this of itself, as it were, without any [illegible], as [illegible] pointed out. The reason for this is that the field, being fed with a constant potential, is therefore of constant strength, and a slight variation in speed of the armature, about 5 per cent., will vary its current from zero to its full capacity, and therefore vary its power to any extent.

Method 2 is differential winding, Fig. 2 [illegible] constant speed [illegible] within 1 or 2 per cent [illegible] attained. [illegible]

[illegible] weakening of the field magnet is well known, being due to the lowering of the counter electromotive force, and consequent [illegible] the field magnetism [illegible]

In the next three methods the external resistance in [illegible] field, or both, is varied. [illegible] and is hardly allowable [illegible] by destroying the main [illegible] entire circuit. Method [illegible] circuit is very much less objectionable, and is very convenient and common,

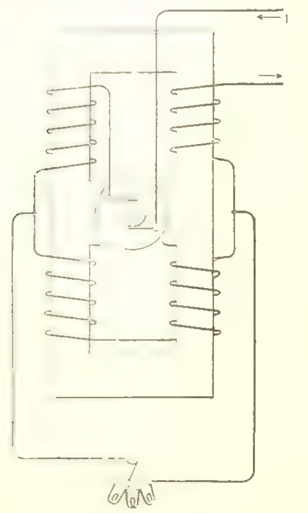
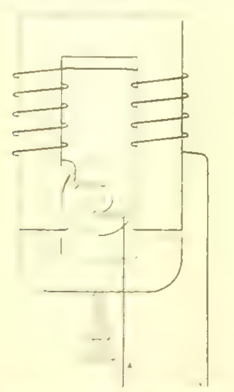


Fig. [illegible] Series Motor with Variable Magnetic Shunt.

Fig. 3. This mode can be adopted with a very small loss of current, because the field current is only a small part of the total current used in the motor, and the loss of a portion of this small fraction is practically insignificant. Method 5—having external resistance in series with both the armature and field is open to same objection as Case 3, since it throttles and destroys part of the main current.

The next five modes of regulation, 6, 7, 8, 9 and 10, are theoretically more economical than the preceding, because we vary the internal or useful resistance instead of adding external or dead resistance. Method 6, in which the internal resistance of the armature is varied, is very difficult to carry out in practice, simply because it is hard to get at and change the connections of the armature while it is revolving. One of the few ways devised to accomplish this is to wind the armature with two or more circuits connected to a corresponding number of commutators, whereby one or more of these circuits may be used, thus varying the internal resistance and torque. This is clumsy, and practically little better than using two or more separate motors.

Method [illegible] the field coils in series is a very simple and common plan. It is the ordinary way of regulating constant current or other series-wound motors. This method, or some modification of it, is one according to which the constant current or "arc" motors of the Baxter [illegible] C. and Excelsior companies are constructed. Method 8, of cutting out field coils in multiple arc, is shown [illegible] applicable to shunt wound motors. The different layers, for example, may be respect[illegible] points of a switch and



which a great variation in the total internal resistance of the machine is obtained.

The next method, No. 11, is open to the same objection as No. 6, because when the armature is shunted the main current of the machine is affected. Shunting is, however, less objectionable than dead resistance, because in most cases it is better to divert the current than to destroy it.

Method 12, like methods 4 and 7, is a useful and common one, because in shunting the field we are merely handling a very small fraction of the total current.

Method 13, varying a shunt in multiple arc with both armature and field, is wasteful like No. 11. It was, however, the plan by which the first arc motors were regulated, a variable shunt being placed in the main circuit and the motor connected to the terminals of the shunt.

The variations in the shunt, of course, throw more or less current through the motor, thereby varying its power as required.

Method 14, varying the current in a separately excited field, is merely historical, as this class of motors has gone out of use. The plan, however, is a very effective one, because, of course, it is very easy to control the field current when it is produced by a separate source.

Method 15 is shown in Fig. 7, and consists in shunting the field magnetism, *i. e.*, diverting the lines of force from the armature through some other path. In the arrangement shown in Fig. 7 there is a simple series wound motor with consequent pole field magnet, and if the coils exciting one magnetic circuit are short-circuited it is evident that the magnetism produced in the other magnetic circuit will be short-circuited or shunted by the former. The short-circuiting of the coils is effected by the variable shunt, as indicated.

Method 16 is very similar to the preceding, and consists in short-circuiting the field magnetism and diverting it from the armature by a keeper, which may be moved toward or away from the pole-pieces by means of a screw or other contrivance.

We now come to methods 17, 18 and 19, in which the line of commutation is varied. The first is the well-known plan of shifting the brushes. This is very effective and easily carried out, and has, therefore, been used quite extensively, but it has the very serious and almost prohibitory objection that when the brushes are moved from the neutral point they spark very badly. This may be remedied to a slight extent by some heroic plan like blowing out the spark produced. But, as sparking is one of the worst drawbacks of a motor, it hardly seems as if this method of regulation would be permanent.

Methods of regulation which are all right for dynamos may not be allowed in the case of motors, because the former is usually in the hands of skilled men devoted to its

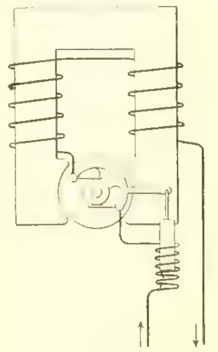


Fig. 9.—Series Motor with Automatic Device for Shifting Brushes.

care, while motors are often run by ignorant and careless persons.

Method 18, shifting the commutator, is simply another way of doing the same thing as shifting the brushes.

Method 19, shifting the magnetic resultant or direction of lines of force in the armature, may be accomplished by two sets of pole pieces, the relative magnetic strength of which is varied. This is also open to the same objection as shifting the brushes.

Method 20, shown in Fig. 10, consisting in moving or separating the pole pieces from the armature, has been used in the Diehl and other motors, but it is rather difficult to carry out mechanically, and introduces a hinge or joint in the magnetic circuit, which is, of course, very undesirable.

Method 21 moving the armature away from the pole pieces, is very much easier to accomplish mechanically, and has a great many advantages as a means of regulation. S. S. Wheeler and myself have been working for some time on motors in which this method of regulation is employed, and the results we have obtained have been very satisfactory, in fact we have found it to be extremely [illegible]

The [illegible] table gives a list of the possible cases of motor [illegible] direct or continuous current. [illegible] important quantities or [illegible] in connection with electric motor regulation [illegible] with reference [illegible] motors are [illegible] Motors are always [illegible] and in trade, as constant [illegible] constant or variable [illegible] motors, hence [illegible] upon the [illegible] are at [illegible] The [illegible] and [illegible]

ordinarily used in practical as well as scientific work. We find that there are in all sixteen different cases, in the first four of which the potential is constant; in the second four the potential and current are both constant; in the third four the current only is constant, and in the fourth four neither the current nor the potential is constant.

Case 1, in which the potential alone is constant, is the case of a series-wound motor, for example, with variable load on a constant potential circuit. Such a motor would rise in speed when the load was reduced, and vice versa. It would not be at all self-regulating; in fact, it would tend to run at a very high speed with light load, and a very low speed with a heavy load. It is possible to give various other examples, but one is sufficient in most cases. In this case, however, I may say that the ordinary street car motor, fed from a constant potential motor, is also an example of Case 1, the current being controlled by varying

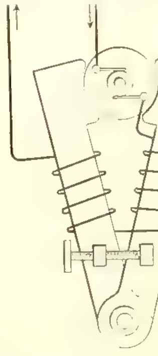


Fig. 10.—Series Motor with Device for Moving Pole Pieces Apart.

the external or internal resistance, according to one of the methods given in the first table.

Case 2 is that of the ordinary shunt or differential motor, with a variable load on a constant potential circuit. This is self-regulating and maintains its constant speed, as already stated, and is the commonest case of motor regulation met with. The current varies directly with the load.

Case 3 is that of the ordinary shunt motor with constant load, having a variable resistance in the field magnet. This case is shown in Fig. 1. Increasing resistance of field circuit would weaken field magnetism, and the motor would run faster and take more current; *i. e.*, current would vary directly with speed.

Case 4 is not a practical one, because, if potential, speed and load are constant, the current cannot be varied without wasting it; that is, any excess of current would be simply destroyed, which, of course, is not permissible.

Case 5 is not likely to occur, because potential and current would not be constant with a variable load and speed, but if it did occur it would require that the speed and load should vary inversely.

Cases 6 and 7 are not practical for the same reason as given in Case 4, because if potential, current and speed were constant the load could not be reduced without wasting electrical energy, and in Case 7 the speed could not be varied without wasting energy.

Case 8 is that in which all four factors are constant, and is best illustrated by a shunt motor with constant load on a constant potential circuit, in which case the current and speed would also be constant.

Case 9 may be illustrated by a shunt motor with variable load on a constant current circuit. The speed would run up as the load reduced. A more common example is a series motor on constant current circuit, with switch for cutting out field coils, or, in short, a constant current motor with variable speed and load.

Case 10 is that of the regular constant current or arc motor with governor, such, for example, as the Baxter or C. & C. motor. The ordinary form of this motor is a series governor with a centrifugal governor which operates

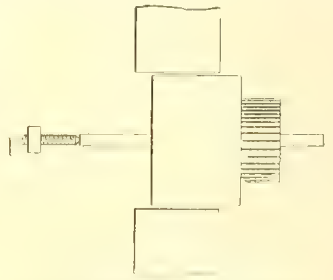


Fig. 11.—Series or Shunt Motor with Regulator for Moving Armature Out of Field.

a switch to cut in and out the field coils, as shown in Fig. 8. This is next to the shunt and differentially wound motors, the most common and important case of motor regulation.

Case 11 is that of a constant current motor with constant load, with switch for varying field strength. The potential would rise directly with speed, but this case is not likely to occur.

Case 12 is not practical, for the same reason as case 4.

The last four are those in which both potential and current vary. They are hardly practical cases, because electrical distribution is almost always either constant current or constant potential. It is, however, of course, pos-

sible to have cases where both may [illegible] each case are given.

Case 13 is one which does not [illegible] practice, for example, if a so called constant [illegible] varies slightly, as they always do in practice [illegible] 10 amperes, then the current [illegible] variable, and this must be taken into [illegible] tion.

In the experiments which I have already [illegible] Wheeler and I have [illegible] a motor [illegible] type which will govern for wide variations [illegible] as in load. This motor, for example, [illegible] even though the current be reduced [illegible] which is a great variation for this type [illegible] field and armature being in series, the [illegible] square of the current. This variation [illegible] called constant current circuits [illegible] age than the variation in potential [illegible] potential circuits, and amounts to from [illegible] amperes.

Having generally described the different cases of motor regulation, let us take up the mathematical [illegible] of potential current, speed and load, which [illegible] quite simply.

Using the symbols P, C, S and L, [illegible] above we have $P \times C$ as the total electrical energy supplied to motor in watts or $\frac{PC}{746}$ in horse power. [illegible] commercial efficiency a, the actual mechanical horse power developed by motor is $\frac{aPC}{746}$ expressed in electrical terms. The equivalent expression in mechanical terms is $\frac{2\pi SL}{33{,}000}$.

Since the point at which load L is measured [illegible] one foot from center of shaft and travels 2π feet per revolution, or $2\pi S$ feet per minute, this, multiplied by the load and divided by 33,000, gives horse power developed by motor.

Thus we have:

$$\frac{aPC}{746} = \frac{2\pi SL}{33{,}000} = \text{horse power of motor}$$

or

$$PC = \frac{746 \times 2\pi SL}{33{,}000 \times a} = \frac{SL}{7.04 \times a}$$

For convenience we may write $PC = \frac{SL}{7a}$ with an error of about one-half of 1 per cent.

If the efficiency a, of motor is 85.2 per cent., the denominator $7.04a$ becomes 6 exactly, and we have $PC = \frac{SL}{6}$, and if the efficiency is 75.8 per cent, we have $PC = \frac{SL}{[illegible]}$.

The former is as high and the latter is as low as is ordinarily met with in practical work, therefore these are the limiting values.

The equation $PC = \frac{SL}{7.04a}$ or one of the three simplified forms just given, may be advantageously used for solving problems in motor regulation. If we know any four of the quantities we may, of course, find the fifth by simply solving the equation with respect to it. It is also evident that if any three of the quantities are constant then the other two will vary directly or inversely with each other, depending upon their position in the equation. This is the ordinary case we have to deal with in regulation. Usually speed is required to be constant, either potential or current is maintained constant, and efficiency should be practically constant down to very small loads; thus we have either current or potential or load varying directly with load. The efficiency is rather a confusing element in motor regulation. For this reason it was not introduced as a fifth quantity in the second table, as it would have complicated it and made a great many more possible cases. The efficiency should be high (close to 100 per cent.), and as nearly as possible constant; therefore it would not affect the figures much.

If the load or speed is zero, or very low, the potential or current should be correspondingly reduced and the efficiency would remain constant. This is the condition for perfect regulation. Practically it always takes some current to overcome friction, etc., even when load is zero, in which case efficiency is zero, but this current should be very small.

The equation $PC = \frac{SL}{7.04a}$ applied to the cases marked "not practical" in second table, shows in case 4 for example, that if PC and L are constant, efficiency [illegible] decreases directly with reduction in speed. This is not allowable. The same is true of the other cases that it is not proper to vary PC or L simply at the expense of efficiency, or in other words, waste current to obtain regulation.

Having now given the general points of the subject of motor regulation, we will proceed to consider the forms of motors which are now being used.

First, and most important, we have the regular shunt motor for constant potential circuit, which has already been referred to several times. Thousands of this type of motor are in use, and give very satisfactory results. A properly designed motor of this kind will regulate within 5 per cent., which is near enough for most purposes.

It has no regulating mechanism or complicated circuits to get out of order, and it may be called the ideal self-regulating machine. The next important form is the differentially wound motor, which is even more perfect in closeness of regulation. Theoretically, and it might be made almost absolutely constant in speed, practically the speed varies about 2 per cent.

These are the figures given me by the company who manufacture these machines in the largest quantity and of the most excellent workmanship. Silvanus Thompson gives an example of one of these machines which only varied [illegible]

[illegible] of the shunt coil weakens the current in it, and consequently [illegible] more perfect insulation.

The shunt or differentially wound machine may be varied in speed by putting resistance in the field circuit, as shown in Fig. 1. This may, of course, be done automatically, or by hand, usually the latter.

The next important type of machine is the constant current motor. As already stated, this is merely a series-wound machine, with switch for cutting in and out the field coils, the latter being operated by an automatic centrifugal governor, as indicated in Fig. 3, or by hand. Various modifications of this type have been made; for example, a reversed coil having a variable resistance in circuit with it, may be used in multiple arc with regular series field winding. If this resistance is very high, the reversed coil has little or no effect; if this resistance is made very low, it will rob the main coil of its current and also neutralize its effect, thereby greatly reducing the strength of the field magnets.

Constant current machines with regulator are now in great demand for arc circuits, in fact, it is not practical or safe to use a motor on an arc circuit without a regulator. The differentially wound [illegible] of constant current motors to maintain constant speed is not practicable. The solution of it requires, either that the efficiency should be very low, or that storage batteries be used in combination with the winding, to maintain a constant difference of potential. Any such plan as this is of course very objectionable.

The three types just given are really about the only continuous current motors used to any extent in practice, and it seems that there is at present no demand for any other type.

Nothing has been said of the regulation of alternating current motors, because it is a radically different subject, and moreover alternating current motors tend to run synchronously, maintaining a constant speed and regulating themselves.

In conclusion, I would say, that I hope to see this subject taken up by leaders in electrical science, and given the attention which I think it deserves, and which it has not yet received.

The Relation Between the Initial [illegible] Efficiency of Incandescent Electric Lamps.

BY WM. H. [illegible]

At the present day there is very little reliable published information relative to the variation with age of the economy and light giving power of incandescent lamps. However well this law of variation may be known to lamp experts, the author believes himself to be justified in saying that the majority of electrical engineers are entirely unacquainted with it. The most complete data, and the latest, at least in this country, is that given in a report in 1885 to the Franklin Institute by a committee appointed to test lamps and dynamos. At that time the successful commercial lamp was but two or three years old, and since then the development of lighting by incandescence has been so remarkable as to cause this lamp test now to be almost ancient history. When considering the possibilities of incandescent lighting in depots, offices and shops the fact of the absence of trustworthy records of late date induced the following investigation to be made by the author in the interest of the Chicago, Burlington & Quincy Railroad company.

There were in all 94 lamps studied, embracing four of the most prominent makes of lamps now on the market. Fifty nine of these were purchased—15 of 3 kinds and 14 of one type of lamp. Care was exercised to obtain the commercial lamp. After the preliminary measurements had been made upon these 59 lamps, the local agents for them were invited to make examination of the test room and of the methods pursued. As an outcome of their visits the remaining 35 lamps were upon their solicitation, tested. These lamps were in every case sent direct from their respective factories especially for this test, which fact I am rather prone to construe as a vote of confidence by the various lamp companies in our system of measurements.

The Howell voltmeter was used for determining the volts in all measurements, and the following is a brief description of its principle. The pressure to be measured is caused to drop through the resistance [illegible] Fig. 1, equal to about 4,000 ohms and a Daniell cell [illegible] so arranged that when the key K is closed the electromotive force between $C D$ is opposed by that of the battery, and hence no current passes through the galvanometer G, when the electromotive force between C and D is equal to that of the cell. In practice the rider [illegible] is moved along the resistance until no current flows through the galvanometer, and the electromotive force between [illegible] determined from the formula

[illegible]

Volts between [illegible]

[illegible]

TABLE NO. 1.

[illegible]

In this table it is shown that on [illegible] and [illegible] all four cells were apparently [illegible] with one another. [illegible] three cells out of four; January 26th, February 11th, February 27th, five of six cells; March 14th three of eight cells; April 1st, two of seven cells, and April 29th, four of the nine cells were O K. And further, that the maximum variation at any time between any two cells was 1¼ per cent. It is [illegible] seen that we are [illegible] our electromotive force was practically constant.

The cells were mounted on a switch board, so that any two or all of them could be connected in multiple series by inserting plugs and they were compared with each other by rapidly substituting first one and then another of the cells in the voltmeter while measuring the electromotive force of the test room circuit. The last two or three cells received were always used when making determinations on lamps.

The ammeter was of the Bergman solenoid type having a range of from .2 to 1.0 ampere. The readings of the instrument were calibrated at the beginning of the test by copper voltameters, the $CuSO_4$ solution [illegible] a specific gravity approximating 1.1 [illegible] the area of the cathode was 4 square inches per ampere measured. The coulomb equivalent was taken as .0003288 gr. The arrangement for calibration was as sketched in Fig. 2, where A is the ammeter, L a lamp to consume the electrical energy, V a voltmeter and R an adjustable resistance for keeping the pressure uniform at the lamp terminals, as indicated by the voltmeter, and hence [illegible] constancy of current. The circuit through the voltameters was kept closed for fifteen minutes as timed by a stop watch. Extreme care was exercised in preparing the plates and the preventing of oxidation between weighings. The following table shows the current indicated by the ammeter and that obtained by the voltameters in the last made calibration by copper voltameters.

TABLE NO. 2.

[illegible]

This table shows that the ammeter [illegible] [illegible]

[illegible]

[illegible] the power of two standard sperm candles; this conclusion being based [illegible]

FIG. 1.

TABLE NO. 3.

[illegible]

Suggs	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2 034	[illegible]
[illegible]	[illegible]	114 6	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	2 080	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.050
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2 074

checked up by the reference lamps whenever observations on the test lamps were about to be made. Table No. 4 exhibits the readings of these lamps. It will be seen that the candle power [illegible] vary from about 4 per cent. below to 4 per cent. above the first readings made on the lamps, and hence this table proves conclusively that the conditions of the test were essentially the same at all times of its duration. In addition it may be said that for the determination of the candle power of these lamps the mean of five observations at the same point was always taken.

TABLE NO. 4.

[illegible] LAMPS.

Date	Lamp No. 1 C.P.	Amperes	Lamp No. 2 C.P.	Amperes	Lamp No. 3 C.P.	Amperes	Lamp No. 4 C.P.	Amperes	Lamp No. 5 C.P.	Amperes
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.11.-	[illegible]	[illegible]								
[illegible]	[illegible]	.500	[illegible]	[illegible]	[illegible]	.483				
1.26.-	9 80	[illegible]								
[illegible]	[illegible]	500	[illegible]	485						
2.27.-	[illegible]	.500								
2.28.-	[illegible]	.500								
[illegible]			[illegible]	.490						
[illegible]	[illegible]	[illegible]								
4.1.-	[illegible]	.500								
[illegible]	[illegible]	[illegible]					[illegible]	[illegible]	[illegible]	[illegible]

watts of electrical energy consumed were determined, and from these were deduced the watts per candle, and the candles per electrical horse power.

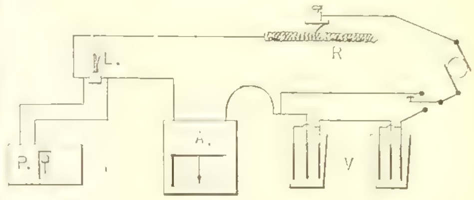


Fig. 2.

In this paper the candle power of a lamp is taken to be the mean of twelve points 30 degrees apart in the horizontal plane of the lamp. The observed candle power is the power of the lamp at a point in the horizontal plane at right angles to the plane of the base of the filament. The reduction factor is the ratio of the mean horizontal to the observed candle power.

In the preliminary measurements three readings were made at the point where the observed candle power readings were to be made, and the lamp was marked so that this point could always in the future be determined. The lamp was then revolved upon its principal axis, and two observations were made every 30 degrees, the starting point, when again reached, also having two more readings made. The five readings made at the starting point were averaged, and the result called the observed candle-power. The observed candle power and the readings at the other

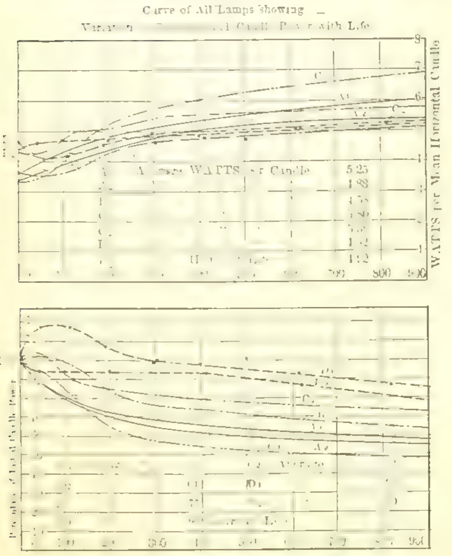


PLATE I

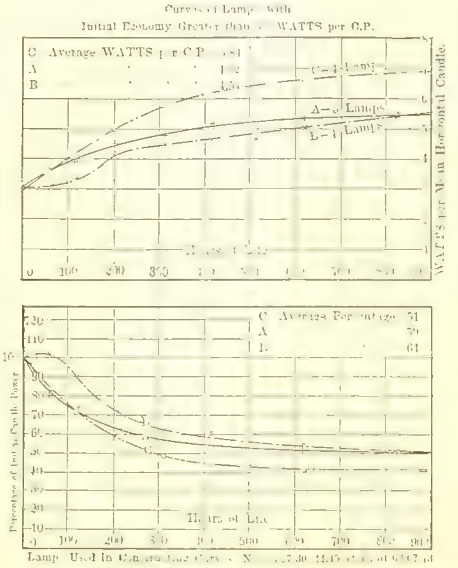


PLATE II

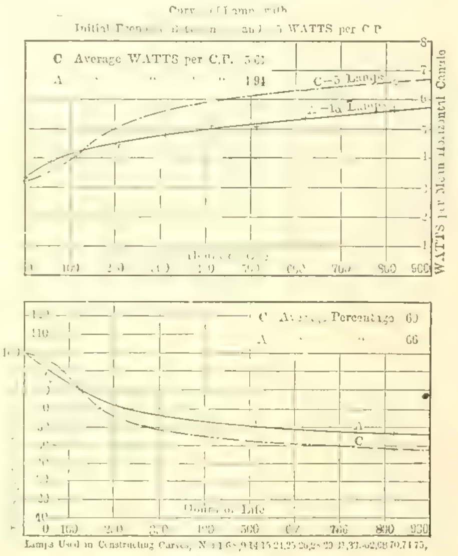


PLATE III

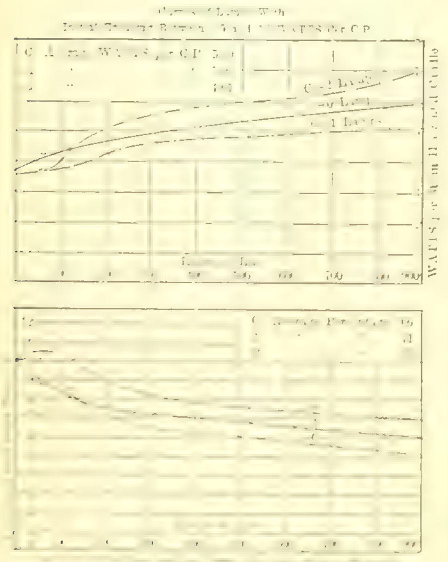


PLATE IV

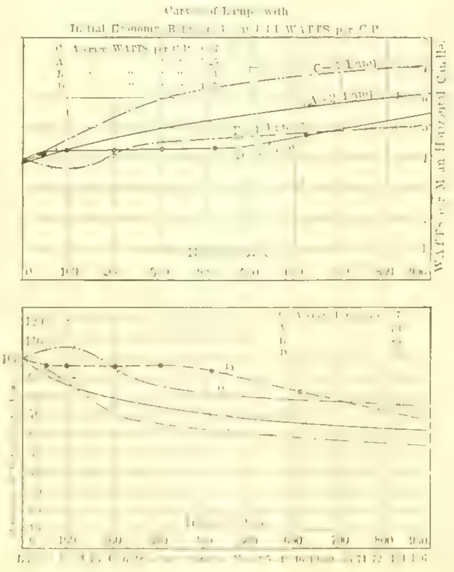


PLATE V

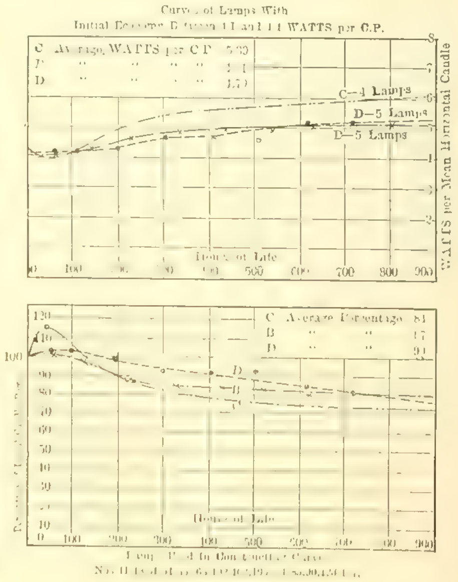


PLATE VI

[illegible] stage, the cur- [illegible]

The lamp test [illegible] August 1, 1898, at which [illegible] preliminary measurements [illegible] of lamps. On account, however, of [illegible] work the test was shortly afterward dropped until late in December. All [illegible]

[illegible] of test lamps [illegible] candle power and the [illegible]

eleven points were then averaged, and this result called the mean horizontal candle power.

The wire connections to the lamp in the photometer were the same as shown in Fig. 2, excepting that no voltameters were in circuit.

A [illegible] curtain was hung from the two photometer [illegible], and an opening was maintained only sufficiently wide to permit the reading of the disk. Two screens of [illegible] glass were so placed as to shield the person making the candle power determinations from all [illegible] of the light. Two observers made the measurements. The other made the photometric readings and

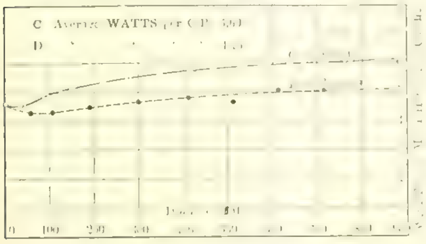
regalated the height of the g[illegible] the flame through deep blue glass [illegible] the lamps in position, adjusted the [illegible] readings, and recorded all observation[illegible]

The candle power readings were [illegible] the mean of at least two observations, and if these [illegible] from each other more than 4 per cent [illegible] made, and a mean of all observations [illegible] correct reading

A small room, 13 by 19 feet, in [illegible] to conduct the test was partitioned off about [illegible] In this room were located the photometer and other instruments, and all test lamps. The door leading to this apartment was kept locked, no one being allowed to enter during my absence except the engineer in charge of the plant, who twice a day inspected for broken lamps. The photograph of a portion of the room shows the method of hanging the lamps. They were wired in groups of 10 and 15. Lamps of similar marked volts were placed together.

Curves of Lamps with [illegible]

Initial Economy Between [illegible] WATTS per C.P.



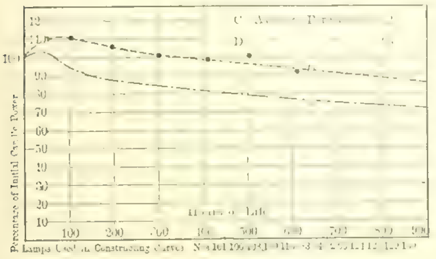
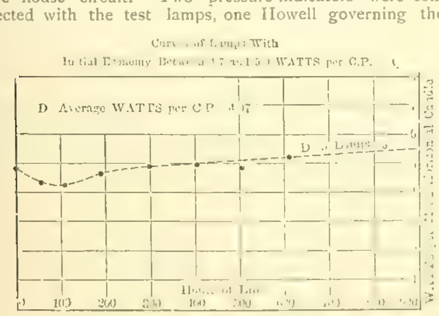


PLATE VII

The volts labeled on the lamps by the manufacturers was taken as being the correct pressure at which to run the lamps. Suitable resistance was introduced into those circuits which required a less pressure than 110 volts, the normal pressure of the house circuits. No lamps were permitted nearer to each other than 12 inches, for fear of possible harm occurring to one from the heat of the others. The temperature of the air when all lamps were burning was about 104 degrees Fahrenheit, as indicated by a thermometer near the center of the room. The current was turned off and on the lamps during the first 550 hours in a gradual manner, such as was due to the starting and stopping of the dynamo, but after this time arrangements were made to also have the lamps switched off and on once or twice daily, so that the filaments would receive the shock of sudden heating and cooling as in usual practice. Excepting when photometric measurements were being made, the lamps burned whenever the dynamos ran, which was generally 9 hours per diem, 4¾ hours in the morning and 4¼ hours in the afternoon, with one hour intervening. In the mains leading to the test room was interposed a variable resistance coil by which the pressure at the lamps could be adjusted independently of that of the house circuit. Two pressure indicators were connected with the test lamps, one Howell governing the

Curves of Lamps With

Initial Economy Between 4.7 and 5.4 WATTS per C.P.



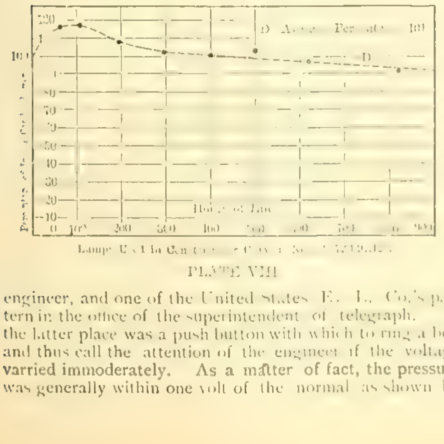


PLATE VIII

engineer, and one of the United States E. L. Co.'s pattern in the office of the superintendent of telegraph. In the latter place was a push button with which to ring a bell and thus call the attention of the engineer if the voltage varried immoderately. As a matter of fact, the pressure was generally within one volt of the normal as shown by [illegible]

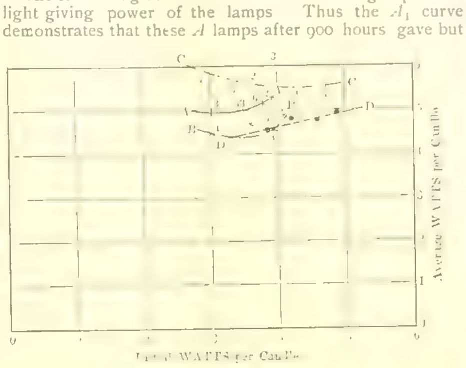
[illegible]

In the accompanying curves [illegible] designated by a letter A, B, [illegible] and [illegible] the purchased lamps. [illegible] tested at the request of the lamp companies. In [illegible] case [illegible] letters refer to the make of lamp.

[illegible] first of these, Plate I, is shown the variation [illegible] the economy and candle power of all the [illegible] curve represents [illegible] from 10 to 15 lamps [illegible] A_1 lines relate to the 15 lamps purchased, and the [illegible] indicate the influence of life upon the lamps contributed by the C lamp company.

The upper set of curves illustrate the economy of the several lamps at their different periods of life. Thus the A_1 curve indicates that these 15 A lamps when new consumed 3.54 watts per mean horizontal candle, that after 900 hours 6.1 watts of electrical energy were necessary to produce one candle power of light, and further that during 900 hours the mean economy of the lamps was 5.25 watts per c. p.

The lower diagrams indicate the effect of age upon the light giving power of the lamps Thus the A_1 curve demonstrates that these A lamps after 900 hours gave but



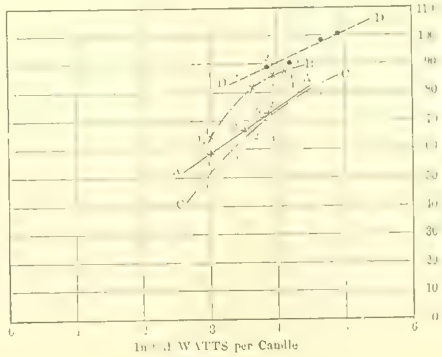


PLATE IX

58⅙ per cent. of the initial candle power, and that the mean intensity of light during 900 hours was 67 per cent. of the new lamps

In the construction of the second series of curves, Plates II to VIII inclusive, the lamps have been divided into groups according to their initial economy. Thus A, 2 and 5; B, 43, 46, 49, 50, C, 66, 71, 72, and D, 121 and 126 are all lamps consuming when new from 3.5 to 3.8 watts per candle, and have been used to construct Plate V. We have 7 sets of comparative curves, the various lamps in each set having approximately the same initial economy.

In the third series, Plate IX, we have a summation of all previous diagrams and tables. These curves show the relation between the initial and average efficiency of the incandescent electric lamps studied. These curves are plotted with the initial economy of the lamps as abscissæ, and the corresponding averages deduced from the preceding curves as ordinates. The figures at the plotted points have reference to the number of lamps used in determining each point.

From these curves we learn that the varying of the initial economy between the limits of 3 and 5 watts per candle does not greatly affect the average economy, but it does have a very marked effect upon the average candle power derived from the lamp.

CORRESPONDENCE.

New York Notes.

New York, June 1.—Mayor Grant has at last adopted a change of policy toward the electric companies of this city, and at the two meetings of the Board of Electrical Control last week showed a different spirit toward the companies. He says he has agreed to the issuance of permits to string wires, because he has been convinced that [illegible]

[illegible]

it has been referred to the grand jury. The following communication has been forwarded to District Attorney Fellows by the mayor: "I [illegible] from S. S. Wheeler, electrical expert of the Board of Electrical Control, dated May 2[illegible] relating to the [illegible] of electric lamps at different places in this city. The mayor is informed by Commissioner Gibbens that no permit was issued in any of these cases which are in violation of the law. The mayor desires that you take such action in the premises as may be proper."

The trial of the alleged electric sugar refining swindlers still continues, and from the present outlook will last a month longer. The direct examination of President Cotterill of the defunct company was ended yesterday, and his cross examination will be taken up next Monday when sensational developments are promised by the defense. Some very amusing testimony was given by Cotterill in regard to the machinery for the refining of the sugar. Friend said that the machinery when finished would have to be put into iron bound boxes, so as to prevent the exposure of the machinery in case of any accident. The boxes were made and laden at night by Friend and Howard. One of the boxes which was particularly large and valuable was named Jumbo. The defence laughingly asked, "Then you saw the elephant?" and the recorder interrupted, "No, he only saw his skin." In general the trial is growing more and more dull, and the recorder seems to be getting anxious as it is spinning out to such a length.

An interesting legal point in selecting a jury in the trial of murderers since the new form of execution by electricity was adopted, has been discussed and decided by the Court of Sessions in Brooklyn in obtaining the jury for the trial of James H. Graham. It is declared by the court that, because a man is opposed to the new form of capital punishment by electricity, he is disqualified to serve as a juror in a murder trial. The decision has caused a good deal of discussion among the lawyers since the court ruled the disqualification, on the ground that there is a statute disqualifying a juror for bias. Whether a man is actually disqualified as a juror because of his objections to this mode of punishment, or whether his being excused is left to the discretion of the trial judge, is the question, and the opinion of some well-known lawyers is interesting:

General Roger A. Pryor—"The statute disqualifies a juror only when he has a conscientious bias against capital punishment It makes no difference what the methods of punishment are. He is not permitted to serve as a juror because his conscience will not allow him to bring in such a verdict as will condemn a person to death."

Charles W. Brooke—"I think a juror who has a conscientious bias against capital punishment by electricity is disqualified by the statute from serving as a juror. If a man had opinions against hanging [illegible] competent to serve. The [illegible] the methods by which the prisoner is to be punished if declared guilty."

[illegible]

[illegible] electric current [illegible] the execution [illegible] found guilty [illegible] he has such conscientious scruples as would prevent him from finding [illegible] composed [illegible]

[illegible] holding such [illegible] I do not think. [illegible] The statute [illegible] punishment."

More than usual interest was observed in the metal exchange Thursday, as a keen and sustained rise in copper on the London market had taken place. On the local exchange there seemed to be a good deal of a puzzle to the copper men as to the advance in the London market, as they had received no advice from their London correspondents. There is but one explanation so far, which comes from a member of a jobbing house, who says: "It is simply a twist of the market. The shorts in London have got heavy coverings to attend to by June 10th, and [illegible] to make a strong market."

A deserved swindle was worked upon the proprietor of a hotel in the vicinity of Madison Square, who wanted his house fitted with improved electric bells. He objected to the price asked by a reputable bell-hanger who had made him a bid, and accordingly engaged the services of a work man that he picked up. He furnished the money for all [illegible] and when the push button [illegible] at the office, money was given the workman to purchase an annunciator, but he failed to return. Upon examination it was discovered that only about a foot of wire had been stuck into the plaster behind each button, and that all the wires that appeared in the house were but short bits of less than three feet in length.

The [illegible] tower at Hell Gate, which in times past illuminated the entire northern part of the city, but which has ceased to shed its electric rays to the pilots in that vicinity, will be moved. Several attempts have been made to pull it over by means of wire cables, but they are unable to stand the strain. It is proposed to blow off the legs with dynamite, and then it would fall over from its own weight, but a permission was not forthcoming. It is decided to at last take down the tower in section.

W. H. T.

San Francisco, Cal.

SAN FRANCISCO, May 25.—The subject of writing machines used for telegraphic purposes will be considered by the San Francisco Electrical society at its next meeting.

The California Electric Light company has placed [illegible] with the Brush Electric company for a 1,000 light alternating plant.

The Willamette Falls Electric company of Portland, Ore., has completed its circuits from Oregon City to that place, and expects to be in active operation in two weeks. The company is now operating lights from Thomson-Houston, Brush and United States dynamos, and in a short time will have its Westinghouse installation completed.

[illegible] Telegraph company is stringing additional [illegible] Portland and Seattle.

The state prison directors have been agitating the subject of [illegible] San Quentin and Folsom prisons [illegible] about 1,200 in[illegible]

[illegible] having its road [illegible]

[illegible] thinks that for about [illegible] erected throughout the [illegible] year of about [illegible] purchase by the city of dyna[illegible] contracting for more [illegible]

The Redwood City Electric Light company was incor[illegible]

[illegible] creditable [illegible] returned

A line is being surveyed for the Seattle electric street railway, forming a valuable four-mile addition to the present system. The Seattle Electric Railway & Power company is making extensive preparations for trebling its present power plant. It is now operating a 100-horse power engine and 80-horse power generator, and to this plant will be added two engines and generators of the same capacity. These will be used to operate more cars, and to furnish power throughout the city. Four new cars will arrive shortly from the Thomson-Houston company.

Last Tuesday there was a conflict between the city authorities of Santa Cruz and J. J. Woodward, an electric light agent. The latter claimed the right to erect poles and wires without the permission of the city fathers. This assumption they resented in a very practical manner, by chopping the poles down as fast as set up. The arrest of Woodward for misdemeanor followed. He retaliated by charging the superintendent of streets with malicious mischief. Woodward claims his right under the constitution. The city owns and operates an electric light system, and denies the power of private parties to use the streets without a franchise. Applications had been made, but were denied on the ground that a new system would interfere and compete with the public system. The matter is now in the courts.

The Thomson-Houston Electric company, through its agent, Samuel H. Taylor, has closed a contract at Ukiah, Cal., for a 600 light alternating plant.

W. G. C.

Nashville, Tenn.

NASHVILLE, June 1.—Nashville will soon have a new electric light plant. M. C. Wheaton, representative of the Thomson-Houston Electric company, which transferred its bids for furnishing electric lights to the city to the Capital Electric company, says operations will be begun immediately. The foundations for the building to be erected at the corner of Front and Whiteside streets are nearly completed, the poles for the north circuit, No. 1, are nearly up, and the wires and cables are on hand. The Thomson-Houston company will supply the plant.

The Thomson-Houston company will install an electric light plant for the lighting of the pumping station.

The Edison phonographs and the Bell graphophones will soon be introduced into the state, as a company is to be formed immediately.

Electric cars were put in operation on the Vanderbilt line last week.

The injunction suit of the Telephone company against the Electric Railway company to restrain the latter from operation has been compromised. The Street Railway company agrees to supply the Telephone company with metallic return circuits if the operation of its road interfered with the telephone service. Accordingly, the Street Railway company ordered the copper wires for the return circuit which the Telephone company now claims is necessary, and they will be placed forthwith.

Last week a swinging sign pressed a guard wire against the electric railway wire, and the guard wire was burned in two. It swung down to the ground for a distance of several blocks falling on a man and woman. Both were severely shocked.

An alarm of fire from the top of the telephone building caused a stampede among the telephone hands last week. The cause of the blaze was the electric wire of the street car company coming in contact with a telephone wire on Broad street. Three hundred wires were burned out.

The Knoxville Cumberland Gap & Louisville Railroad company will immediately construct a telegraph line connecting Knoxville and Middleborough. It is thought that the line may soon become a part of the postal telegraph system between Knoxville and Louisville.

M.

St. Joseph, Mo.

ST. JOSEPH, June 1.—The city engineer has prepared plans for the electric power house of the city, and in a few days will advertise for bids. The house will be located on the north side of [illegible] street, near Fifth street. A side track from the Rock Island road will facilitate the handling of coal. The building will be eighty-five feet long, forty [illegible] feet high. It will be supplied with [illegible] roof [illegible]. The smoke stack adjoining [illegible] feet high [illegible] cost about $2,000. The [illegible] July.

[illegible] the ordinance for [illegible] The [illegible] of the late [illegible] opposed [illegible] the petition [illegible] finally [illegible]

THE ELECTRIC LIGHT.

The Brush company has secured the contract for lighting the streets of Griffin, Ga., by electricity.

The Columbia, Tenn., Electric Light company will introduce a Thomson-Houston plant in that city.

Elizabeth City, N. C., will have an arc and incandescent plant soon. A local company will operate the plant.

The Hill City Electric Light company of Vicksburg will probably introduce an incandescent light plant soon.

The Sawyer-Man Electric company of New York, on May 27 received orders for 14,750 incandescent lamps, and still this is a dull season.

The Alabama Fuel, Light & Supply company of Mobile has been reorganized under the title of the Alabama Electric Light & Power company.

The Butte Electric Light company of Butte City, Mont., has increased its capital stock, and will add to its plant a 750-light incandescent machine.

It is stated that a new electric light company is to be organized in Lexington, Ky., for lighting the streets and furnishing lights for individuals.

The Westinghouse Electric company will erect a station at Eufaula, Ala., and the Thomson-Houston company is contemplating a similar movement.

Guthrie, the principal town in Oklahoma, will soon have an electric light and power plant, as a company is organizing to introduce it in the land of the boomers.

The Doggett Dry Goods company of Kansas City will illuminate its new building by electricity. The plant will consist of a 300 light incandescent dynamo and two 30 arc lamp dynamos.

The Chicago Arc Light & Power company has purchased the plant of the King Electric Light company, 138 and 140 State street, Chicago. The plant was of the Schuyler system with a capacity of 85 arc lights. The sale was made on May 22d.

The Commercial Electric company of Detroit is making arrangements to put a $3,000 electric light plant in the northern part of the city. It is designed to furnish incandescent lights, which the company claim they can do at a cost not to exceed that of gas.

The Empire City Electric company are the sole selling agents for the United States and Canada of the genuine soft cord Vienna carbon points manufactured by the celebrated Hardtmuth & Co. A large consignment is expected the latter part of June.

The Royal Electric Light company of Montreal, Canada, is filling the following orders: Quebec, 1,000 light plant; Moncton, N. B., 600 light plant; Winnipeg, two 500 light plants; Peache's Island, for residence, 200 light alternating plant; Winnipeg, 40 arc light plant.

A Washington, D. C., dispatch says: The treasury department has ordered the inspector of electric lights to go to Minneapolis and investigate the needs of the new building there in the matter of wires and lights. Possibly a contract will be made for wiring the building.

A contract with the city of Alexandria, Va., for sixty double arc lamps, 120 series incandescents with necessary station equipment, steam plant, etc., has just been closed by the Schuyler Electric company of Middletown, Conn. The city will be illuminated for the first time July 4th.

The Lakeside, Minn., Light & Power company has been formed with a capital of $50,000, to furnish electricity, gas and water to the village of Lakeside. The incorporators are: D. G. Cash, Edgar Brown, J. L. Fuller, W. Van Brunt, J. E. Marvin, W. E. Perry and E. E. Sherwin.

The city attorney of Jackson, Mich., recently forwarded to the legislature the proposed amendment to the city charter authorizing the establishment and operation of an electric light plant by the city. In addition to furnishing light for streets, the act provides for furnishing light and power for private uses.

The residents of Winchester, Va., celebrated the introduction of the Schuyler Electric company's plant in that place with a big parade and fireworks. The streets were lighted by electricity for the first time, and the people were pleased with the new lights. The capacity of the plant will soon be increased.

At a recent meeting of the board of directors of the Chicago Arc Light & Power company, A. F. Bennett, the secretary and treasurer of the company, resigned to take a position with Crane Bros. C. H. Wilmerding, the present superintendent, was elected to fill the vacancy, and will, at the same time, continue to act as superintendent.

The Brush Electric Light company of Detroit recently offered to string all its wires within a radius of one mile from the City Hall, in the alleys, if the city will give the right of way. The council committee will think it over. It is not at all probable, it is stated, that it will agree to this proposition, however. There is an ordinance requiring the wires to be buried. The city counselor has proceedings under way to force their burial, and the council has instructed him to proceed against some of the electrical companies as public nuisances, because of their overhead wires.

Leonard & Izard of Chicago, have just secured an order for installing 5,000 16 candle power lamps in the works of the Elgin Watch company. This is said to be the largest isolated plant in the world in a factory building, and with the exception of the Chicago Auditorium plant, also installed by Leonard & Izard, is the largest isolated plant of any one in the world. Leonard & Izard bid upon a [illegible] plant to give certain results under strong guarantees, not confining themselves to any particular

make of apparatus. On account of the large amount of territory covered, the three wire system [illegible] in this case, and unless other companies [illegible] the purchaser in the use of the three [illegible] system, the [illegible] son company will probably furnish the [illegible] apparatus.

Some idea of what enormous amounts of power are now being applied in electrical industries [illegible] obtained by an inspection of a belt which the [illegible] the Charles Munson Belting company of Chicago, claims will be, when running, the largest leather belt in service in the United States. This belt, now almost finished and ready for shipment from the factory in Chicago, is to be used in the station of the Minnesota Brush Electric Light & Power company of Minneapolis. It is 8 feet 8 inches wide by from 130 to 140 feet in length, and is made up of selections from 300 hides cemented together without rivets. When in place the belt will be endless.

THE ELECTRIC MOTOR.

The Bird street line of the Lynn & Boston railroad is introducing electricity.

A motor circuit is being put in by the Fort Worth, Tex., Electric Light company.

It is expected the electric street railroad at Hartford, Conn., will be in operation within a month.

The Thomson-Houston company recently closed the following contracts: The Citizens' Electric Street railway, Decatur, Ill., 4 cars, 5 miles, Redbank & Sea Bright Railway company, Redbank, N. J., 3 cars, 5 miles, Richmond Street Railway company, Richmond, Ind., 6 cars, 4 miles; Ross Park Street Railway company, Spokane Falls, W. T., 6 cars, $7\frac{1}{2}$ miles.

A bill has been passed by the Connecticut legislature providing that "no electric, cable or horse railroad shall hereafter be constructed across the track of a steam railroad at grade; nor shall any steam railroad cross any such electric, cable or horse railroad at grade, except with the approval of the railroad commissioners." This act shall not affect any railroad now chartered.

According to reports from Pittsburg the offices in the Westinghouse building are now kept cool by electricity. Nicola Tesla, the inventor of the alternating current motor, has completed an adaptation of his motor to a fan, or to the revolving shaft of fans, for the production of cool air. The motors range from one eighth to one-fourth horse power, and are of the simplest construction.

The *Street Railway Journal* of New York, remarking on the wonderful advancement made in electric railway systems, says: "All the indications point to a very large number of railways which will be running by electricity before the end of the season, and the success of those railways in operation upon the electric system last winter, in spite of snow, increases the general feeling of confidence among the railways' managers, in electrical equipment."

A Cleveland paper says: "The general use of electricity on street railways should reduce the value of horses, but owners of large stables say they have noticed no change in the market as yet. With the whole street railway system of Boston about to adopt electricity, and the tendency in that direction everywhere, it would seem that a surplus of good animals should drift into other channels. In any event the days of horses on street cars will soon have passed."

The East Harrisburg Passenger Railway company, which has been in operation upon the Sprague system for eight or nine months, and which has already once ordered an additional number of cars, has recently sent in a second additional order to the Sprague company for cars. Nothing can more conclusively show the success which electrical railways are meeting throughout the country, and the confidence with which railway presidents regard their equipments than the additional orders which the supply companies are announcing.

The *Pittsburgh Dispatch* quotes one of the directors of the Pittsburgh, Allegheny & Manchester Street Railway company as follows, in reference to an electric system which has been adopted for the road: The idea is to propel each car independently, without a cable, without a slot rail, or any overhead wires, or even a central station and power house. The system is simply this: We have a combination car, of which the one part is occupied by the passengers and the other by the motive power. The latter consists, as the prime mover, of a gas engine, tanks filled with condensed gas, and a dynamo. The electric motor, however, will be placed under the second part. Now, as to the working of the system: The tanks are filled with a sufficient amount of condensed gas to keep the engine supplied for 15 or 18 hours. This will assure us a continuous running of the car without any delay or stoppage. You can therefore readily understand that the entire system is very simple. The little gas engine in the front part of the car is connected with the dynamo, and the dynamo with the motor; so we have everything just exactly where it is wanted. Each car will be fitted up in the same manner, and run independently. All that is required is a filling of the tank in the morning before the cars start out, and then they will run for the whole day without interruption."

THE TELEGRAPH.

C. R. Hosmer, manager of the Canadian Pacific Telegraph company, recently made a trip over the line, giving it a careful inspection. He says wonderful progress has been made in the last two years, and that the outlook for the coming year is excellent, owing to the general prosperity noted on all sides.

The action of the Inter state Telegraph company against the Baltimore & Ohio Telegraph company for $50,000 is one of the [illegible] of the Baltimore & Ohio and the Western Union. It appears that the Baltimore & Ohio company in 1885 entered into an agreement with the [illegible] company that if the latter would [illegible] a line from [illegible] to [illegible], Ind., and [illegible], it would [illegible] business with the Inter state company [illegible] to the other [illegible] on the [illegible] of the other [illegible]. The Baltimore & Ohio Telegraph company agreed that in case it should at any time sell or transfer its lines to any other company it would make proper provision for the Inter state company. The Inter state company alleges that when the Baltimore & Ohio Telegraph company transferred its lines to the Western Union it failed to make proper provision for the Inter state company and perform the conditions of the agreement. It is alleged that this failure on the part of the Baltimore & Ohio Telegraph company rendered the lines of the Inter state company, which cost $40,000, practically worthless.

THE TELEPHONE.

The American Bell Telephone company began an action in Chicago last week to restrain Joseph French & Co. from selling or making telephones which, it is alleged, infringe on the Bell patent.

The Massachusetts legislature has passed the bill enabling the Bell Telephone company to increase its capital stock to $10,000,000, and the governor, it is said, will immediately sign the bill. This will enable the Bell company to engage in its long distance telephone scheme.

When the janitor of the Western Insurance company's building closed up the office last evening, he locked in two young girls, who work on the upper floor, but had not left at the usual time, says a Pittsburgh paper. The girls discovered their predicament some time later, and became badly frightened at the prospect of spending the night in the building. After a few hours had been wasted screaming at the top of their voices to attract the attention of passers-by, one of the young ladies thought of the telephone in the building. She called up the police department, and an officer released them.

Business Mention.

The Electrical Supply company of Chicago has issued a neatly printed catalogue, calling attention to the many excellent qualities of the Cobb vulcanite wire and cable which this company handles. It also presents testimonials from prominent electricians showing their estimate of the Cobb wire.

C. S. Colton, formerly city salesman in Chicago for the Baxter Motor company, is now working the territory in and about Chicago for the Thomson-Houston company and Excelsior Electric company. Mr. Colton, besides installing quite a large number of motors in the city, reports the outlook for an increasing motor business as most encouraging.

The John Stephenson company, limited, of New York, report themselves as well equipped for the supply of cars adapted to all the electric motor systems, as also for cable roads. The large stock of carefully selected, well seasoned and skillfully prepared lumber, gives them unusual facility for prompt delivery, while maintaining the superiority of every phase of their work.

The Eclipse Wind Engine company of Beloit, Wis., has just completed an outfit of its frictional clutch pulleys for the Duluth Electric Light company, and two car loads of frictional clutch hangers, 1,500 feet shafting to the Minnesota company's works at Duluth. The Western Electric company of Chicago and the Chicago Arc Light & Power company are using this company's pulleys and couplings. The Eclipse company's Chicago office is at 60 South Canal street.

The Illinois Anglo-American Storage Battery company, operating under patents of the Anglo-American Electric Light Manufacturing company, has opened offices at 95 Dearborn street, Chicago, and is ready for business. The offices of the company are lighted by incandescent lamps, the current for which is supplied by the batteries of the company, which are charged from the Edison circuit. The lights are bright and steady, and speak well for the efficiency of the battery. Although this type of accumulator has not heretofore been introduced to western trade, it is claimed it has for three years been used in New York and Philadelphia, where such excellent results were attained that the company felt warranted in placing it on the market. Experiments have been made not only in lighting but in furnishing power for street cars, etc., and good results were obtained. The Illinois company desires those who are interested in storage batteries to call at its offices, at 95 Dearborn street, and inspect its plant which is certainly worthy of attention.

Electrical Patents.

Issued May 28, 1889.

403,905. Commutator. Harry H. Blades, Detroit, Mich.
The segments consist of wires. The invention is claimed as follows: "A commutator consisting of the head, of non-conducting material, and rods, the head having the integral shoulder through which the rods are passed, said head and rods turned down to expose segment faces, and in connection therewith the band of insulating material, embracing the head and segments, and dressed flush with the faces."

403,914. Automatic Cut Out for Electric Lamps. Edward R. Knowles, Brooklyn, N. Y.
The invention relates to a novel automatic cut out for electric lamps, the object being to provide means [illegible]

[illegible] supported by said board or strip."

403,[illegible]. Arc Lamp. [illegible]

40[illegible]. Trolley for Electric [illegible] Richmond, Va.
The object of the invention [illegible] prevent the "jumping" of the [illegible] head conductor, and to facilitate the "turning out" as with single tracks, or the "switching" from one track to another, and consists in the combination with the trolley of revolvable guard arms, and in means for locking said arms against rotation in one direction.

403,972. Apparatus for Automatically Regulating Temperature of Steam Generating Tubes. Thomas L. Sturtevant, Framingham, Mass.
The first claim is as follows: "In [illegible] ators having a forced circulation, the combination, with a generator of such [illegible] agency, of water-forcing apparatus, a thermostat controlled by the steam temperature within said generator, and electro magnetic apparatus connected with and operated by said thermostat to regulate the steam delivered to the fluid-forcing apparatus, whereby the supply of water delivered serves to control the temperature of the tubes composing the generator."

404,015. Electrical Switch for Elevators. William E. Nickerson, Cambridge, Mass.
Claim 1 is as follows: "In an electric [illegible] for controlling the motion of an elevator carriage, the combination of a series of cam pieces in the [illegible] the elevator well disposed with reference to the various landings and adapted to act upon a [illegible] device within the carriage and cause the carriage to automatically stop at said landings and [illegible] until the circuit has been manually re established, with electrical circuits having terminals within the carriage connected to said circuit breaking device and [illegible] tric device adapted to actuate the controlling mechanism of the hoisting engine."

404,033. Push Button. Herbert L. [illegible], Lynn, Mass.

404,067. Electric Motor. Warren S. Belding, Chicago Ill.
Claims 6 and 8 are appended: "6. In an electric motor, a plurality of armature sections connected with the plates of the commutator, and a commutator having an annular recess, and wires, and [illegible] material in said recess, said wires connecting the commutator sections into groups, whereby each armature section is brought into circuit [illegible] more than once during each rotation [illegible] tator.
"8. In an electric motor, a plurality of armature sections connected in parallel, a [illegible] recess wires, and an insulating material in said recess, said wires connecting the commutator plates into groups, and [illegible] brushes held [illegible] mutator plates whose connections [illegible] poles of opposite polarity."

404,068. Dynamo. Warren S. Belding, Chicago, Ill.
The invention relates to armatures for [illegible] tric machines and electric motors [illegible] composed of segmental sections [illegible] necting ends, and [illegible] of material, and also to the manner of mounting the armature upon its shaft.
Claim 1 is appended: [illegible] an armature composed of two [illegible] ing sections [illegible] blanks, each of which is [illegible] respective [illegible] spacers

[illegible] Clamp for Electric Motors. Warren S. Belding, Chicago, Ill.

404,112. Automatic Circuit Interrupter for Electric Circuits. Albert L. Reinmann and Philip Lange, Pittsburg, Pa.

The invention is designed to provide a circuit-controlling device which shall insure that the circuit leading to the filaments shall be interrupted and the treatment thereof terminated when the resistance of the filament has decreased to a certain predetermined point.

404,114. Electric Converter Box. Albert Schmid, Allegheny, Pa.

Claim 3 reads: "The combination, with an electric converter having a core composed of thin plates of soft iron surrounding the coils of the converter and having tongues which extend through such coils, of end plates applied to the core, and a converter box having lugs upon its inner surface between which said end plates are held by pressure."

404,118. Apparatus for Treating Filaments. Frank S. Smith, Pittsburg, Pa.

The invention relates to an organization of apparatus for treating and preparing filaments for incandescent electric lamps. Such filaments, after they have been carbonized and before they are placed in the lamp bulbs, are usually heated by electric currents while surrounded by an atmosphere of hydro-carbon gas. The resistance of the filament is gradually reduced during this process, and when it has been decreased to a predetermined point it is desirable that it shall be automatically removed from the electric circuit.

The following claim is given: "7. The combination, with a treating apparatus for the filaments of incandescent electric lamps, consisting of a source of alternating electric currents, a circuit derived therefrom in which said filaments may be connected, and a reactive coil connected in said circuit, of apparatus for cementing or otherwise treating the filaments, also receiving currents from the said source."

404,120. Regulating Self-Exciting Alternate Current Electric Generators. William Stanley, jr., Great Barrington, Mass.

The object of the invention is to provide means for causing an alternate current electric generator to be excited by currents derived from its own armature, and to cause the field magnet strength to be varied in accordance with the variations in the current consumed in the working circuit, so that approximately constant difference of potential may be maintained between the terminals of the generator.

Claims 1 and 3 are appended: "1. The combinations, with an electric generator supplying alternate currents, of a converter having its primary coil connected across the terminals of the armature of the generator, a rectifying commutator through which the currents from the secondary coil of the converter are delivered to the field magnet coils of the generator, and a differential inductive resistance, one coil being included in series with the primary coil of the converter and the other coil in series with the work circuit.

"3. The combination, with an alternate current electric generator, of an inductive resistance wound with opposing coils, one coil being connected in series with the work circuit of the generator, and the other in multiple arc with the work circuit, a converter having its primary coil in series with the last named coil, a rectifying commutator connected with the terminals of the secondary coil of the converter, conductors connecting the rectifying commutator with the field magnet coils of the generator, and means for varying the relative lengths of the coils of the inductive resistance."

404,139. System of Electrical Distribution. George Westinghouse, jr., Pittsburg, Pa.

The object of the invention is to provide means for supplying to electric railways continuous currents derived from alternating electric currents generated at [illegible] remote points and transmitted as alternating currents to points at or near where they are to [illegible] motor.

[illegible] are given: "1. The combination, of an alternate current electric generator, a converter [illegible] secondary circuits, the primary circuit being connected with the generator, an electric motor, an electric railway, and a rectifying commutator driven by said motor, through which currents from said secondary circuit are supplied to said rail[illegible]

"4. The combination, substantially as hereinbefore [illegible] generator, a [illegible] therefrom, a rectify[illegible] from said [illegible] with said rectifying [illegible] charged by [illegible]

[illegible] David A. [illegible]

[illegible]

[illegible] tem, and, having [illegible]

telegraphs and analagous instruments. Claim 4 follows:

"4. The combination, with a main circuit including an electro-magnet, of an auxiliary circuit having branches which include working magnets, a circuit closer operated through the action of the magnet in the main circuit to close the auxiliary circuit, a switch mechanism for directing the current over the auxiliary circuit through different working magnets, and switch magnets also included in auxiliary circuits which are closed and broken through the action of the magnet in the main circuit, a catch mechanism for holding the switch mechanism in its shifted position, and a releasing magnet, for operating said catch mechanism to release the switch mechanism."

404,168. Secondary Battery. Henry F. De B. Cameron and Thomas Harris, Detroit, Mich.

Claim 3 reads: "The combination, with the elements, of one or more supports, of non-conducting material, said support at its upper end projecting between the elements and constituting a washer, and in connection therewith a supporting bolt of non-conducting material passed through the plates and washer, whereby the whole are bound together and to said washer."

404,170. Electrical Signaling Apparatus. John P. Coleman, Swissvale, Pa.

The invention relates to an improvement in that class of railway signals used for controlling a main line of track and a number of branch lines.

The eighth claim is appended:

"8. In a signaling apparatus for railways wherein there are a primary signal and two or more secondary signals, each provided with an electro magnet which controls it, the combination, with the said electro-magnets and their circuits, of railway switches, circuit-controlling mechanisms (such as circuit closers) operated by motion of the railway switches and controlling the circuits of the magnets of the secondary signals the circuit of the electro-magnet of the primary signal being connected with each of the circuits of the electro-magnets of the secondary signals whereby the magnet of the primary signal is operated simultaneously with the operation of the magnets of each of the secondary signals."

404,220. Method of Rendering Nickel and Nickel Alloys Non-Magnetic. Heinrich Ostermann and Charles Lacroix, Geneva, Switzerland.

404,221. Electrical Switch for Elevators. William E. Nickerson, Cambridge, Mass.

The invention consists in placing in the well room of the elevator, vertical metallic strips or wires, some continuous and others severed at each floor, which act as electrodes, and in placing in the elevator carriage a switch block and push buttons adapted to act as switches for connecting the electrodes.

404,226. Fire and Police Signaling Apparatus. Arthur C. Robbins, Brooklyn, N. Y.

404,232. Pole for Electric Wires. Udolpho Snead, Louisville, Ky.

404,244. Arc Lamp. La Motte C. Atwood, St. Louis, Mo.

The first claim is: "In an electric light, the combination of an electric motor provided with a brake mechanism, carbons, screws supporting the carbons, shunt coil and wire, armature operated by the shunt coil, and connection consisting of bars and levers between the armature and the brake of the motor."

404,245. Electric Arc Lamp. La Motte C. Atwood, St. Louis, Mo.

The invention relates to certain improvements in electric arc lamps for use in locomotive head lights.

404,306. Process of Electric Riveting. Elias E. Ries, Baltimore, Md.

The first, third and last claims read:

"1. The method or process of riveting, which consists in first interposing insulating material between the rivet and the articles to be riveted, then inserting the rivet into the rivet hole or holes then heating the rivet by the passage through the same of an electric current of comparatively great quantity and low tension, and then heading the rivet.

"3. The method or process of riveting, which consists in first interposing insulating material between the rivet and articles to be riveted, then inserting the rivet into the rivet hole or holes, then passing an electric current of comparatively great quantity and low tension through the rivet until the latter is heated to the desired degree of incandescence, then heading the rivet and at the same time maintaining the incandescence of the same by the continued flow of current, and finally gradually reducing and cutting off the current while the heading is completed.

"7. The method or process of riveting, which consists in interposing between the rivet and the articles to be riveted a coating of insulating material, then passing an electric current of the requisite volume through said rivet to raise it to the required temperature, and then heading or upsetting the rivet."

404,310. Electric Meter. Robert P. Sellon, Lambeth, County of Surrey, England.

The first claim is as follows: "In an electric meter, the combination of an [illegible] body, such as a pendulum, a counting mechanism, a pawl for actuating the same, a link for transmitting the motion of said pendulum or body to said pawl, [illegible] mechanism, as specified, for varying the point of connection between said link and said pendulum or body, and thereby varying the stroke of said pawl, and a solenoid in the circuit whose [illegible], the core of said solenoid being connected with and actuating said adjusting device."

[illegible] Motor. Charles J. Van Depoele, Lynn, M[illegible]

The invention relates to electric motors and its object is to provide means for regulating the speed and power of the motor and at the same time to so control the flow of current therethrough that it will be commensurate with the results accomplished, that is, with the torque exerted by the field magnets upon the armature, and, further, that the magnetizing effect of the field magnet will be such as to produce in the armature, even at low speed, such a counter electromotive force as will operate to prevent too great a flow of the current therethrough. Claims 1, 2 and 7 read:

"1. In an electric motor, the combination, with the armature thereof, of a long field magnet coil in series therewith, an adjustable resistance, and means for placing any desired portion of the resistance either in series or in shunt relation to the coils of the field magnet.

"2. In an electric motor, the combination with the armature thereof, of a long series field magnet coil, an adjustable resistance adapted to be connected in series therewith at starting, and means for placing said resistance or any desired portion thereof in derivation from the field magnet coils.

"7. In an electric motor, the combination, with the armature, of a field magnet coil in series therewith, an adjustable resistance, a switch, connections between the coils of the field magnet and of the resistance and the switch, and a switch-lever adapted to be moved into engagement with the several parts of the switch and in one rotation to connect the resistance in series with the field magnet coils, then to gradually cut it out, then to connect the entire resistance in derivation from the said field magnet coils, and cut it out altogether."

404,325. Closed Slotted Conduit. Charles J. Van Depoele, Lynn, Mass.

This invention has reference to improvements in conduits for electric railways of the type in which the supply conductor is contained within a small sub-surface chamber communicating with the surface by a continuous opening or slot, which slot is normally kept closed by flexible strips or packing, which, being interposed between the conductor sustaining parts and the exterior casing of the conduit, serves the double purpose of excluding dirt and water, and insulating the said parts.

The ninth claim is appended:

"A conduit for electric conductors, comprising a slotted exterior casing, a conductor or conductors and supports therefor within the casing, flexible or yielding insulating strips between the conductor support and the casing, hollow elastic cushions interposed between the upper edges of the strips and the casing for normally holding the said strips in close contact to close the slot and means for supplying compressed air to the interior of the hollow cushions for increasing their pressure upon the slot closing strips, as desired."

404,332. Process of Separating Ores by Magnetism. Clinton M. Ball, Troy, and Sheldon Norton, West Troy, N. Y.

404,333. Magnetic Ore Separator. Clinton M. Ball, Troy, and Sheldon Norton, West Troy, N. Y.

The last two claims are:

"4. An ore separator comprising, in combination, a group of magnets of alternating polarity, a traveling diamagnetic screen adapted to move across the poles of said magnets, means for delivering the ore to the outer side of said screen, and means for forcing a current of air through the space traversed by the ore as it passes the magnet poles.

"5. An ore separator comprising, in combination, a group of magnets of alternating polarity, a traveling diamagnetic screen adapted to move across the poles of said magnets, and an apron adapted to confine the ore within inductive range of said magnets, and deliver it in close proximity to said screen."

404,334. Process of Separating Ores. Clinton M. Ball and Sheldon Norton, West Troy, N. Y.

A current of air is produced in a direction contrary to the direction of motion of the crushed ore.

404,351. Electric Arc Lamp. John R. Fox, Fort Wayne, Ind.

One of the objects of the invention is to produce a lamp which is comparatively light, weighing only about 10¾ lbs.

The first and third claims read:

"1. In an arc lamp, the combination, with a central frame, of regulating solenoids detachably secured thereto, hollow cores controlled by the solenoids a positive carbon rod extending through the cores, and a clutch controlled by the cores, said clutch engaging the carbon rod.

"3. In an arc lamp, the combination, with the regulating coils, of a vertically movable frame controlled thereby, a clutch, a positive carbon engaged thereby, one end of the clutch being seated loosely in the frame to permit slight vertical and lateral movement, and a tripping device for engaging the other end of the clutch when it reaches a predetermined limit of depression."

404,361. Electrical Apparatus for Controlling Elevators. Ronald F. McFeely, Pittsburgh, Pa.

The first claim follows: "1. The combination, with the main motor, its controlling valve, and the valve rod or stem, of independent secondary motors having pistons which move the said valve rod or stem to effect motion of the main motor in contrary directions, mechanism for disconnecting the respective pistons of the secondary motors from the said valve rod or stem at a middle point of the travel of the latter, valves controlling the secondary motors and electro magnets controlling said valves, and an electric circuit and switch mechanism by which the magnets may be caused to operate either of said secondary motor valves, substantially as and for the purposes described."

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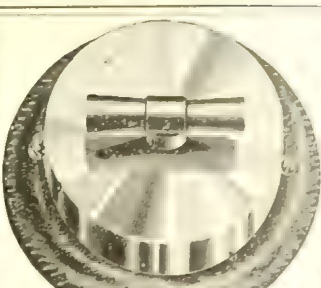

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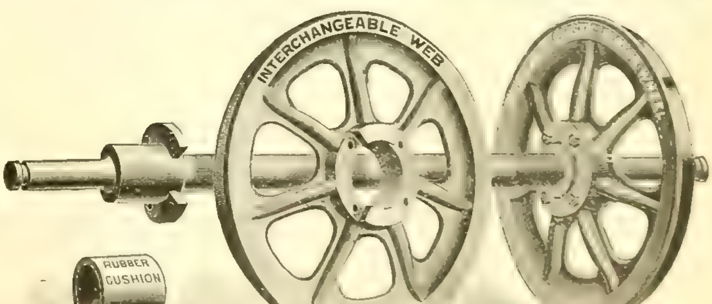

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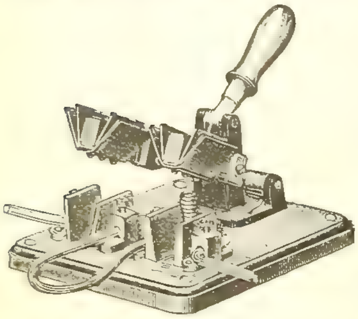

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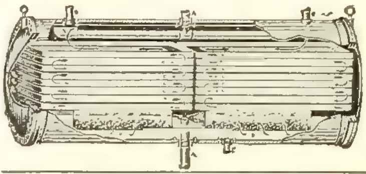

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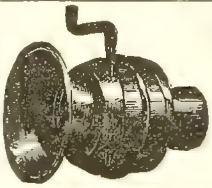

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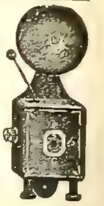

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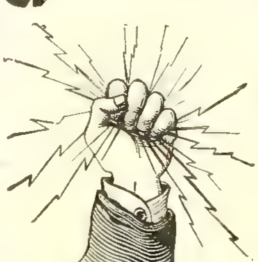

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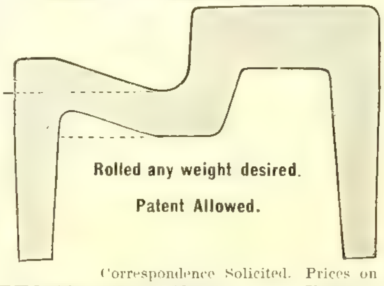

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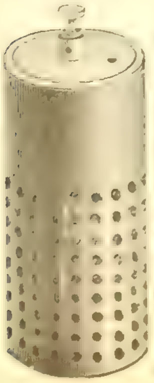

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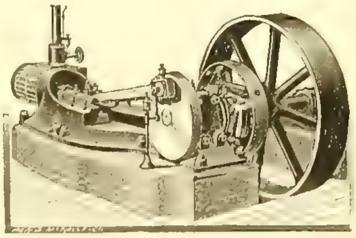

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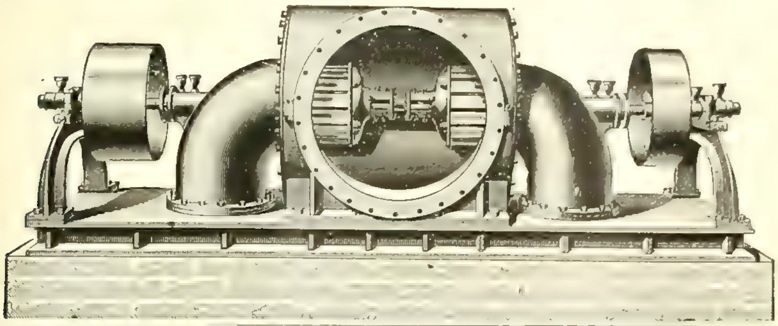

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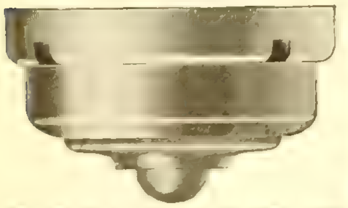

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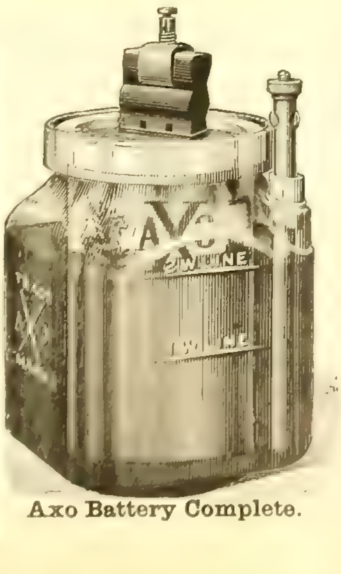

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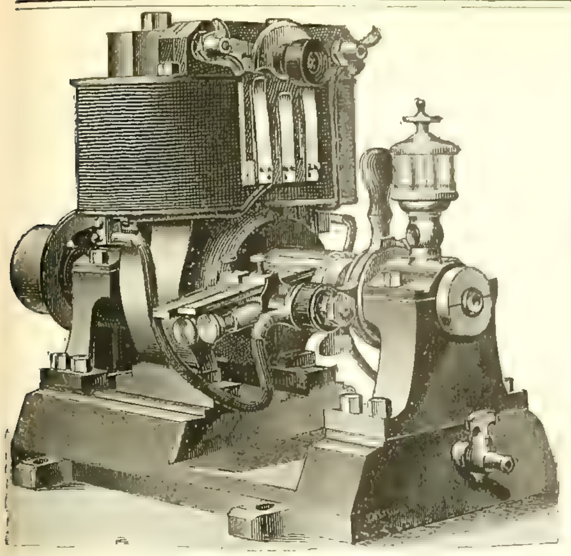

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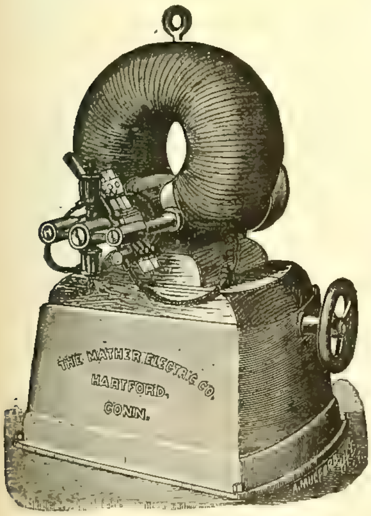

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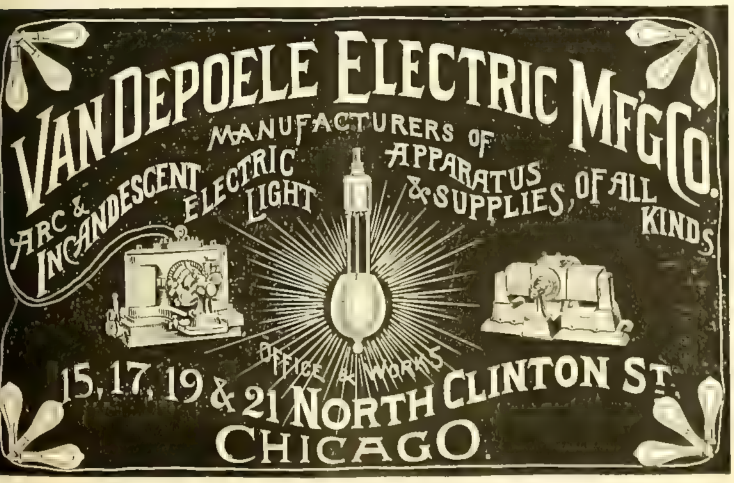

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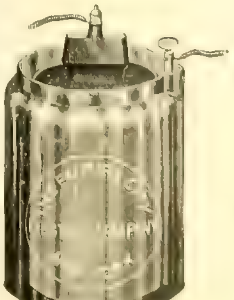

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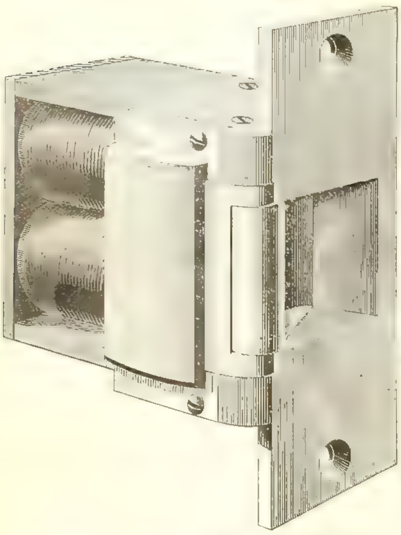

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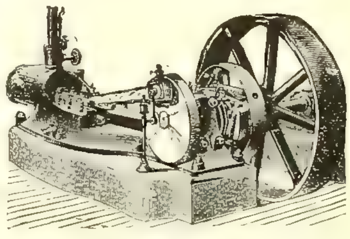

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FACTS OF THE PRESENT CONTROVERSY.

THE NATIONAL ELECTRIC MANUF'G CO.

HOLDS THE KEY TO THE SITUATION

BEWARE OF IMPOSTORS.

"SUUM CUIQUE"

TO USERS OF ELECTRIC LIGHT APPARATUS:

The Edison and Sawyer-Man Electric Light Companies have recently deluged the country with circular letters and bombastic advertisements, setting forth that they have patents, which cover the fundamental principles of electric lighting; and that their patents have been sustained in the Supreme Court giving the exclusive right to manufacture and operate incandescent lamps. Nothing could be more misleading than such statements.

Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simply a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

This company takes the position: First, to defend the users of its apparatus against loss accruing from its use; second, to vigorously and determinedly prosecute Walter K. Freeman's claims for patents covering these inventions.

Our apparatus is of the highest efficiency—mechanically and electrically. We are prepared to guarantee its operation and defend our customers.

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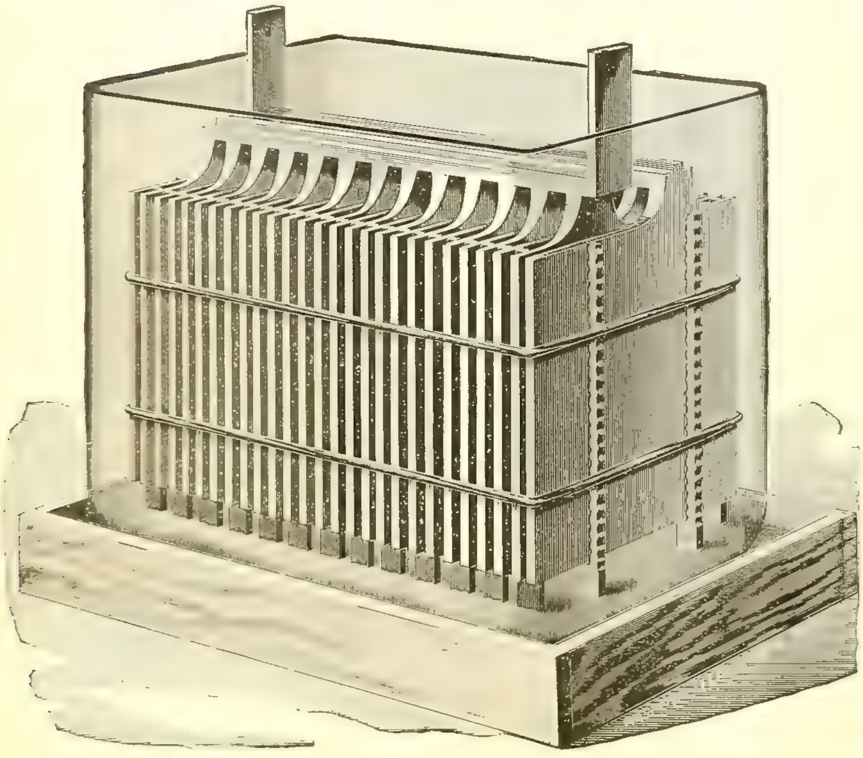

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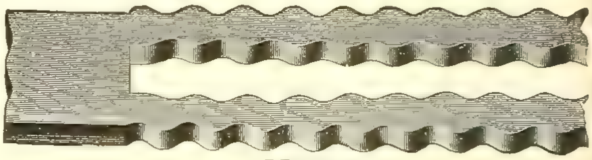

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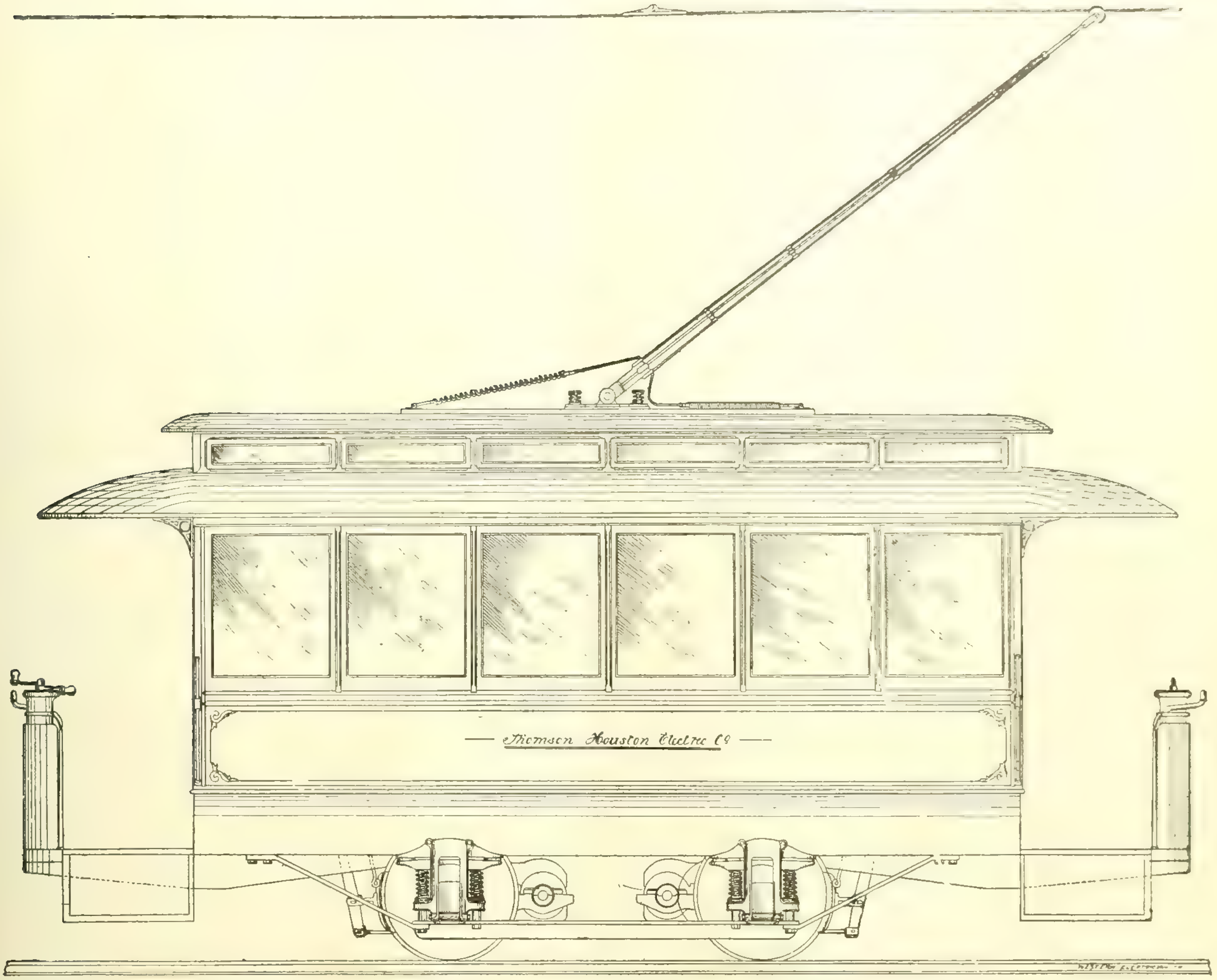

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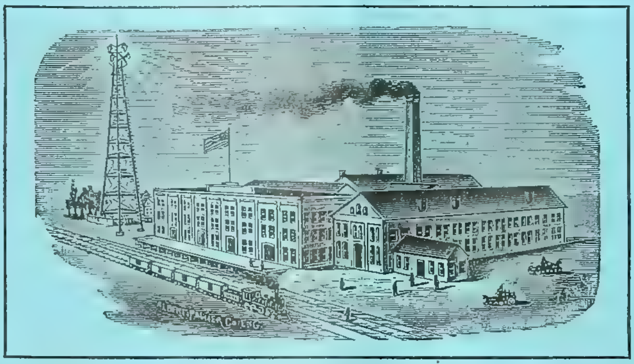

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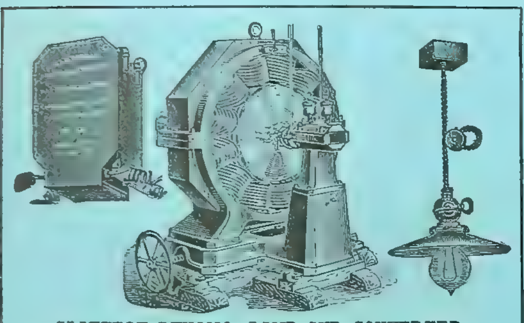

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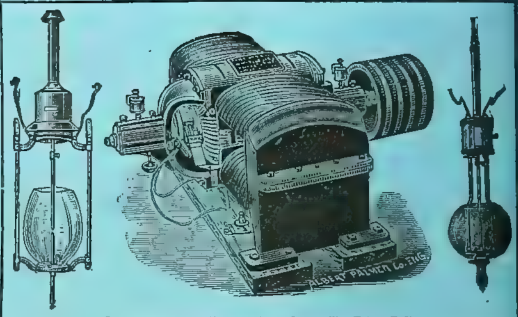

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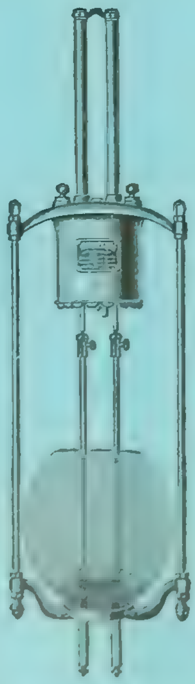

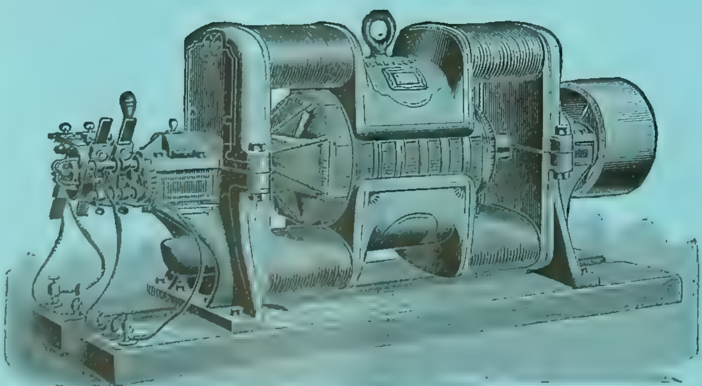

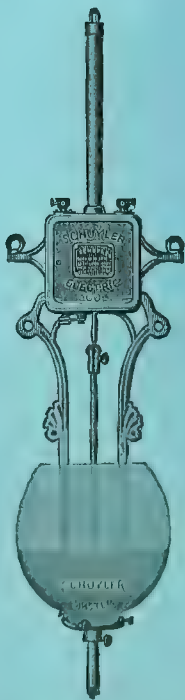

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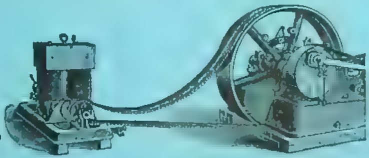

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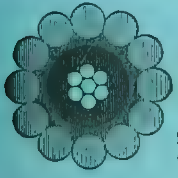

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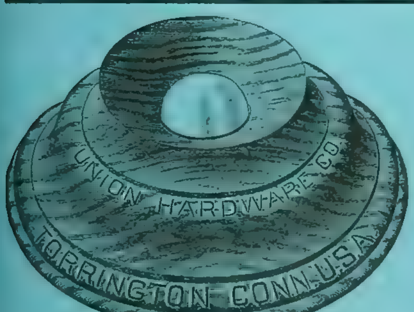

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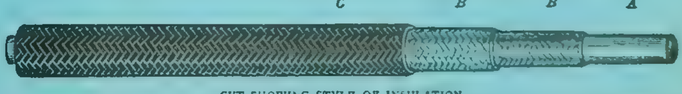

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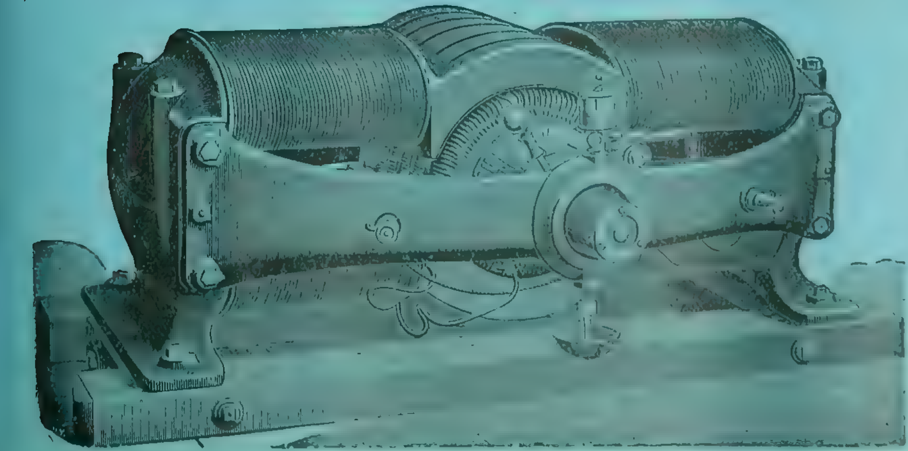

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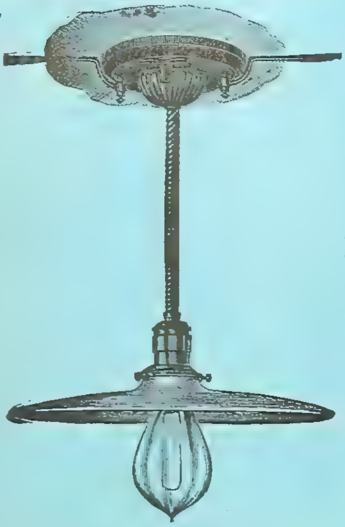

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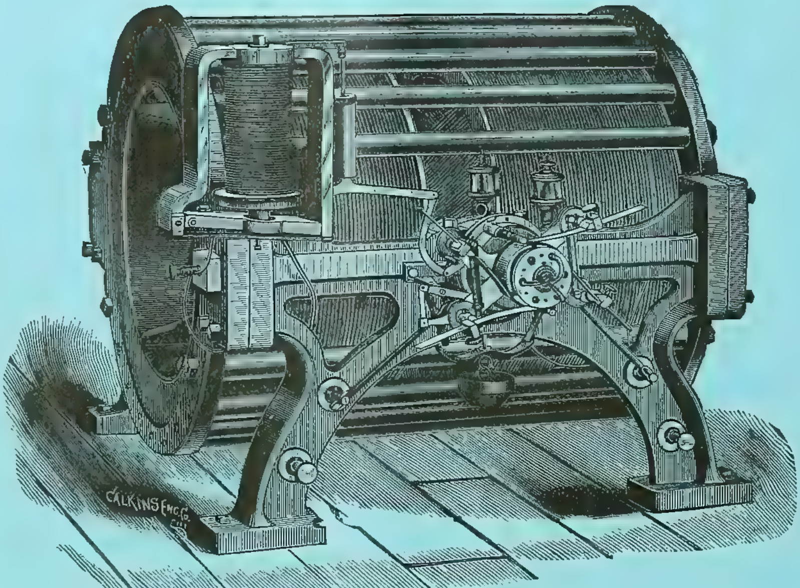

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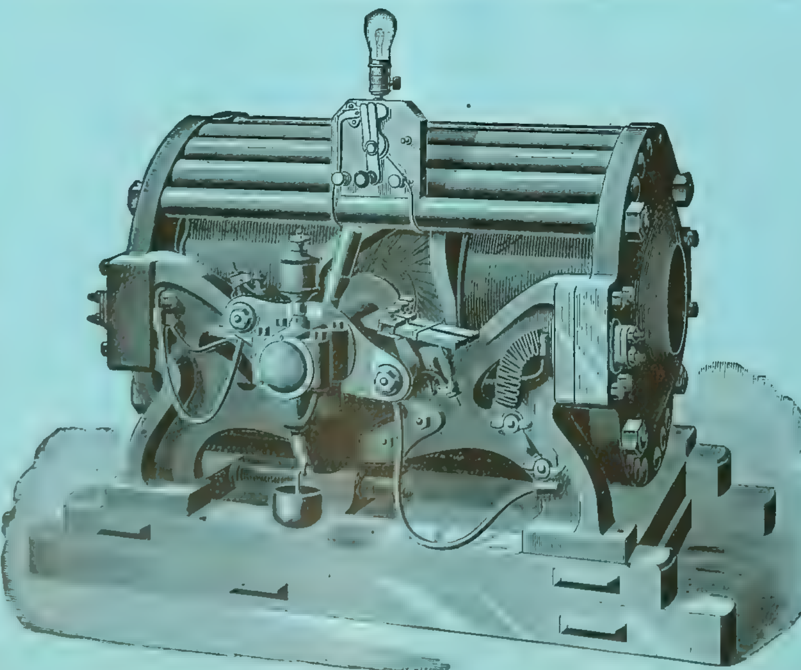

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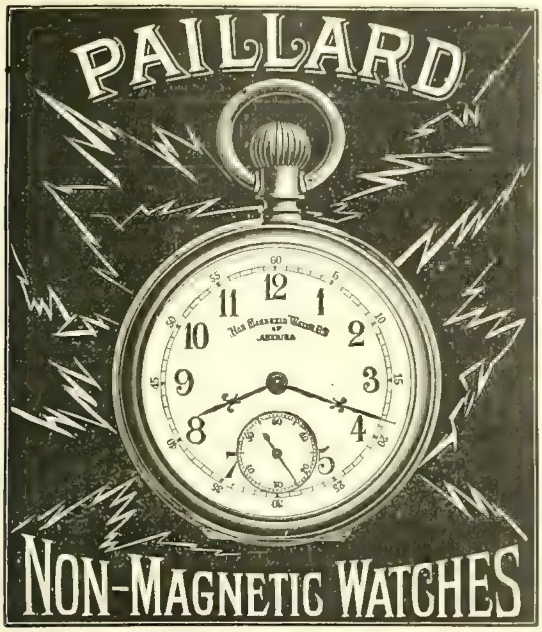

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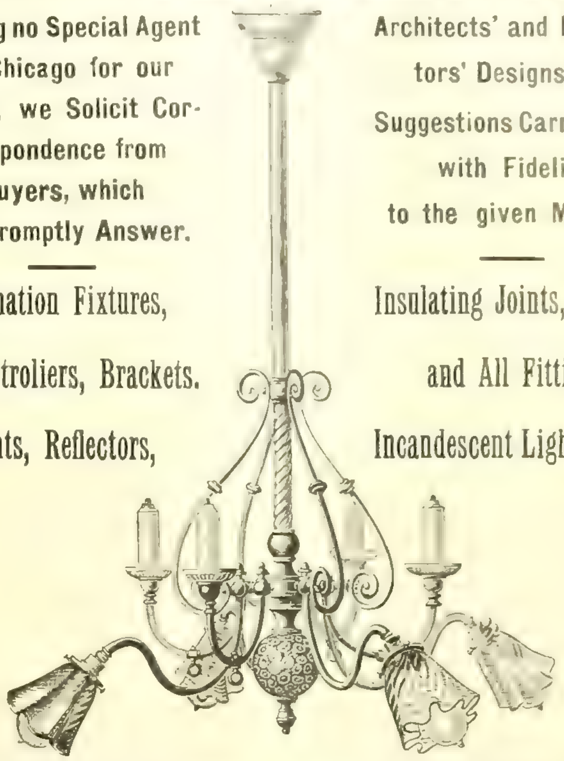

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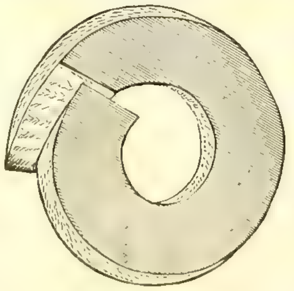

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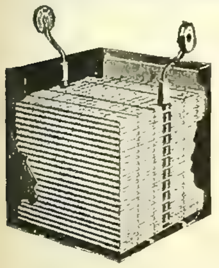

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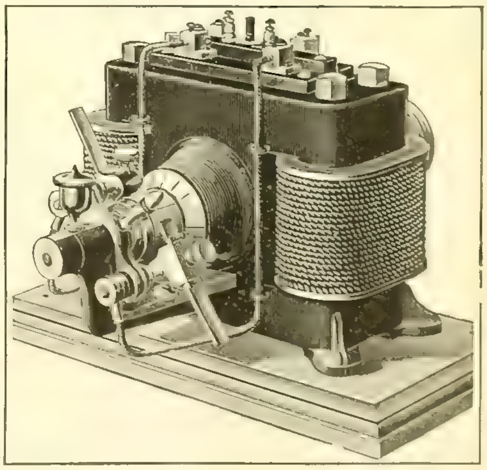

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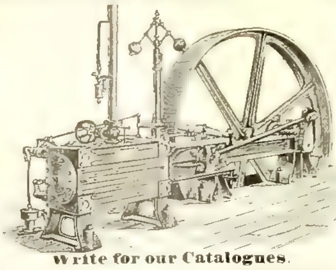

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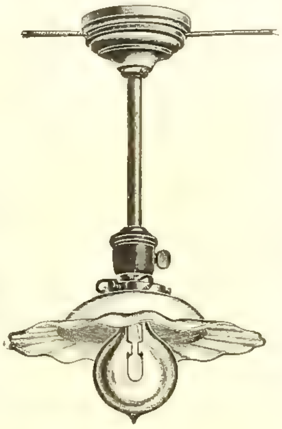

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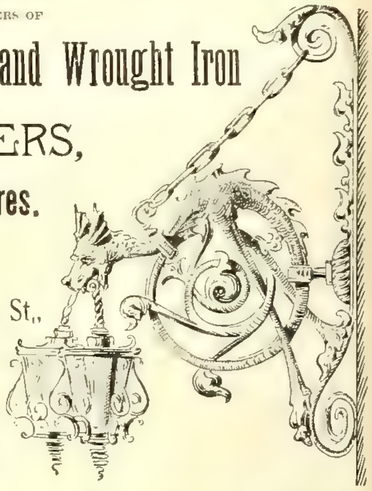

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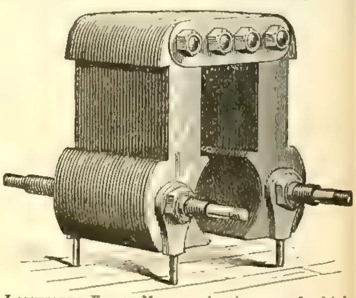

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Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

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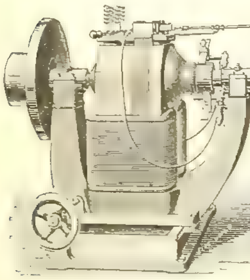

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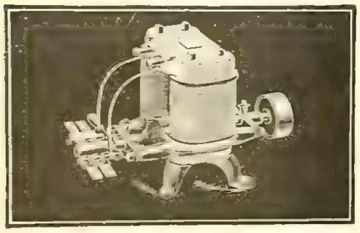

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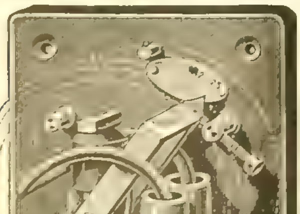

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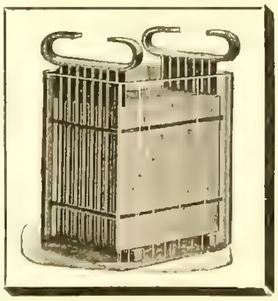

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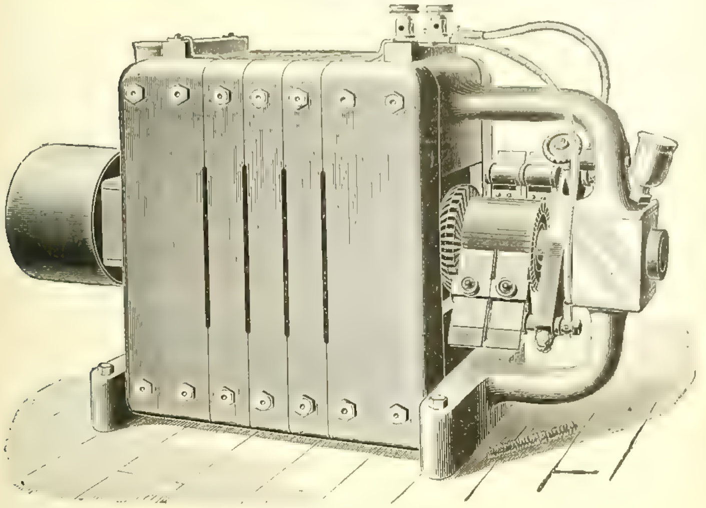

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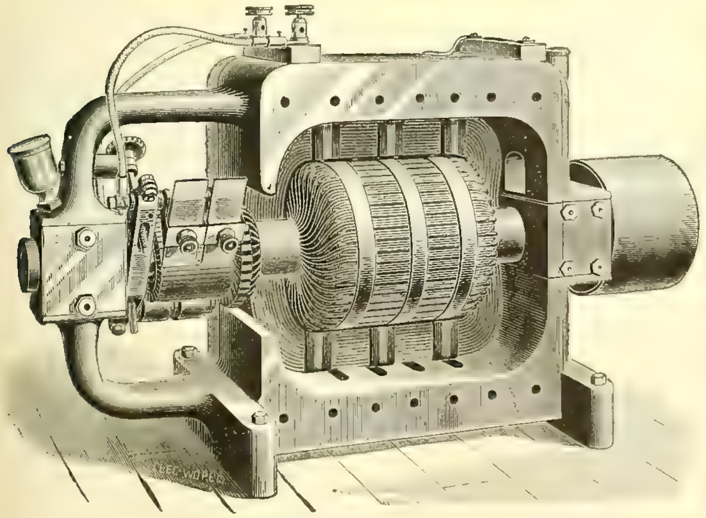

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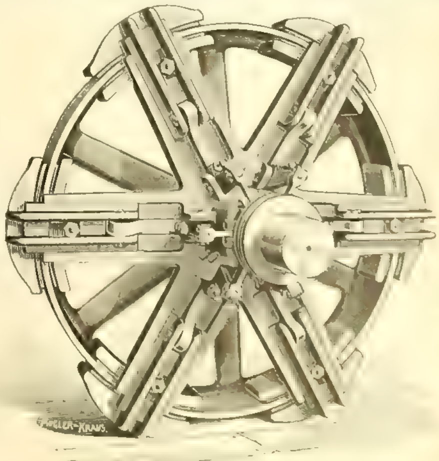

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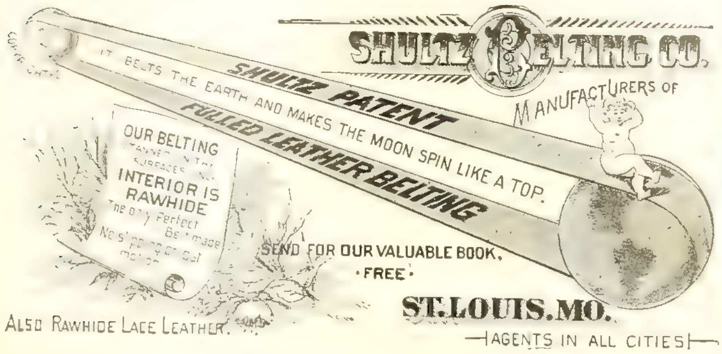

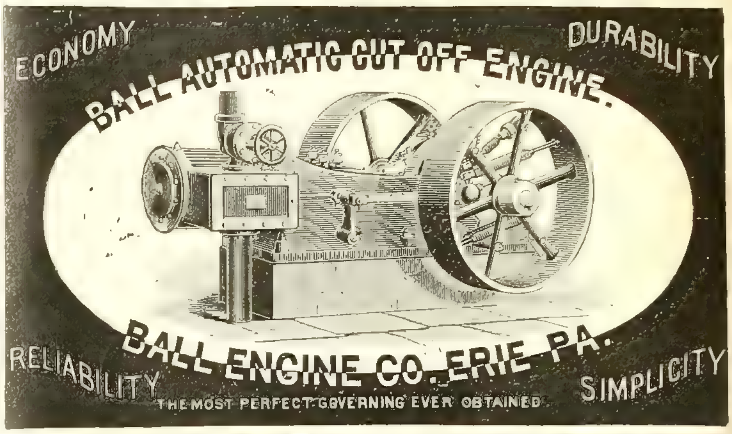

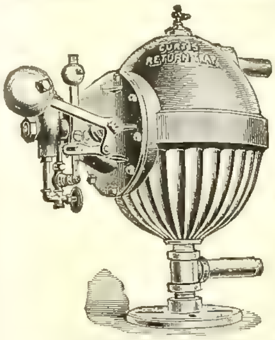

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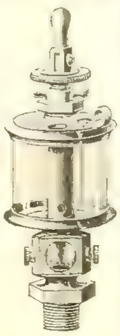

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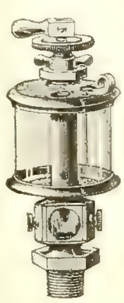

Fig. 2. Shows flow of oil stopped when machinery stops.

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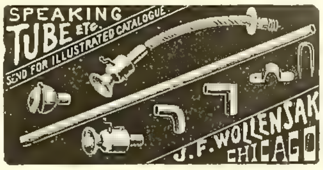

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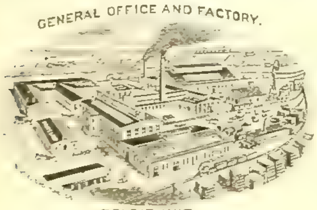

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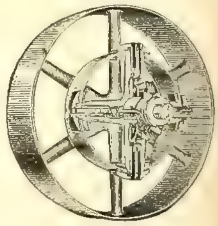

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Electric Light in Cable Cars in a Chicago Tunnel.

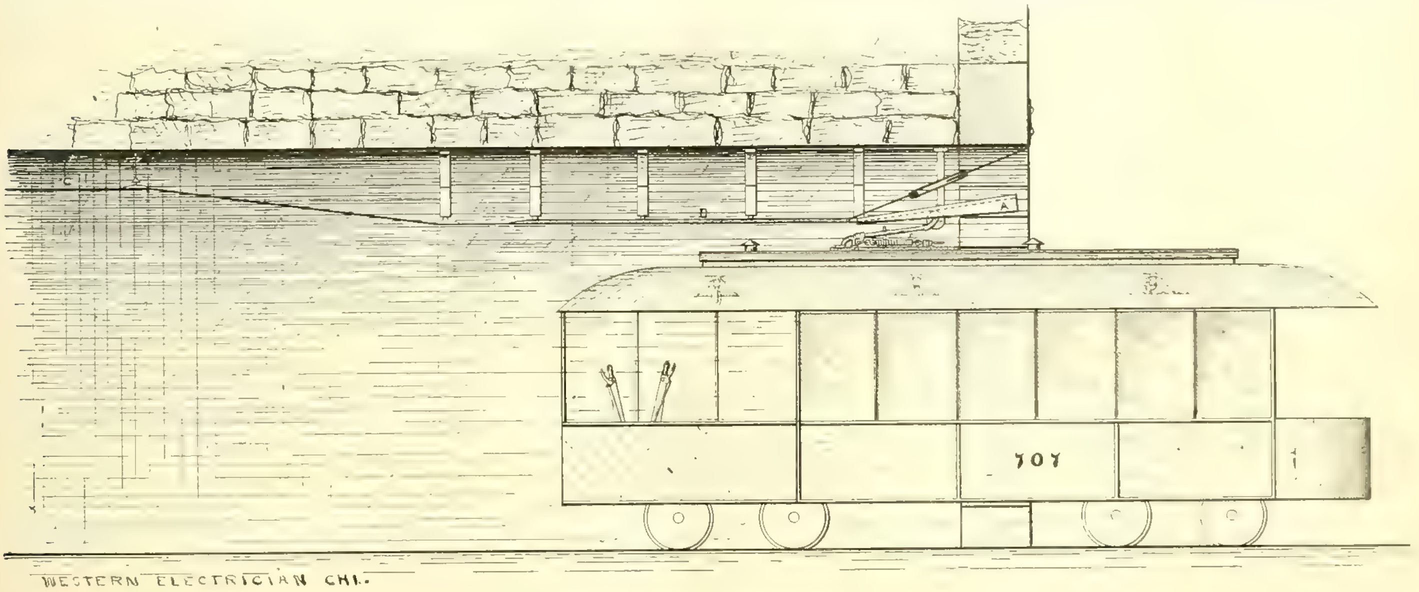
One of the latest novelties in the way of car lighting by electricity is a system which has been applied in Chicago to the cars of the North Side cable street railway. The cars are illuminated by incandescent lamps as they pass through the tunnel under the Chicago river. As is the case in most of the applications of new ideas and methods, numerous small difficulties, which only appear after practical tests, had to be overcome. The scheme, while novel and ingenious, is quite simple. A 100-light, 110-volt Thomson-Houston dynamo, located in the power house of the cable road, about a block from the tunnel's mouth, furnishes current to trolley wires which are suspended one over each of the two tracks, and extend the entire length of the tunnel.

Each car to be lighted is wired for two or three 20-candle power incandescent lamps, the number of lights depending on the size of the car. On the car roof is fitted or hinged a short arm carrying a deep-grooved trolley to make the connection with the overhead wire, and furnish current to the lamps. The two trolley wires are of No. 4 hard drawn copper, and take the current from two "feeders" tapped on to each wire, one at a point about a quarter and the other at three-quarters from the entrance to the tunnel. This method of distribution, which is the same as that used on several electric railways, keeps the potential along the wire practically constant.

The ground is used for the return current, connection being made with it at the car through the grip mechanism. This plan was found more satisfactory, and gave better results than was the case when return was made through the wheels to the rails. The rails in the tunnel being dry and sandy, a poor contact was the result, and this gave more or less trouble.

The accompanying cut shows a car entering the tunnel. The trolley on the roof is guided by a tapering chute or inverted trough into contact with the guide rail, whence it runs to the main trolley wire. The most novel feature of the installation is that which relates to the trolley arm. When the car enters the tunnel the arm is unhooked from a horizontal position on the roof of the car, and is left free. By the action of the spring, *E*, it is brought into contact with the wire. When the car leaves the tunnel the arm is forced back and hooked again in its normal horizontal position. The changes of position are effected by so bending the chute, *A*, guide rail, *B*, and main trolley wire, *C*, that the flexibly hinged trolley arm is first pressed down from the inverted L-shaped hook which holds it in place on the roof. The arm is then carried from under the hook and the trolley left free to bear against the main trolley wire.

The illustration shows only the general arrangement at the mouth of the tunnel as the car enters. The construction at the other end is practically the same. There the trolley arm is guided in under the hook instead of away from it. In this simple manner the cars are lighted as they enter, and the lamps automatically extinguished as the car emerges at the other end. The arrangement was designed and put in operation by Leonard & Izard, Chicago.



ELECTRIC LIGHT IN CABLE CARS.

Telegraph Operators at Johnstown.

The terrible disaster at Johnstown tested the capacities of the telegraph offices at Pittsburg. Manager Williams of the Western Union office in Pittsburg said last week: "I do not remember the time when business in our line was so lively. In Centennial times, and when the strike was on, there was great activity in telegraph matters, but there were far fewer wires in operation then than now. We did not realize the extent of the Conemaugh disaster for many hours after the first news came. Our offices and operators at Johnstown went down in the flood. Since Friday night we have sent fifteen operators to that ill-fated city, with all the appliances needed for telegraphing. The operators do not find the best of accommodations. Many are sleeping in barns, and hunting rations wherever they are to be found. We sent up three additional operators to-day, and will send another to-morrow. There are now in the employ of the Pittsburg office about ninety operators. Ordinarily we employ about one-half this number."

At the Postal Telegraph [illegible] Pittsburg information of the same character [illegible] secured [illegible] said the foreman [illegible]: "Our regular commercial business had been very slack, but the extra business brought by the Johnstown disaster has far more than made up for the loss in commercial lines. The pres[illegible] business since the flood has forced us to quadruple our force. On the night force from twenty-five to thirty men are now kept busy, whereas we were able a week or ten days ago to get along with a half dozen. We have managed to get our wires into good shape, and are equal to all demands, notwithstanding the great increase the past few days."

Night Manager Henderson of the telephone company stated that on Sunday the force was doubled. The amount of business done for four days was 100 per cent. above ordinary times. He said: "Pittsburg has been the center of inquiry from all points for information concerning Johnstown sufferers. We have no line to Johnstown, but have an exchange there. Our operator there, a young lady, was saved, but lost everything, and had scarcely a sufficiency of clothing to protect her from the elements. A gentleman's coat was a part of her covering when rescued from the flood. The lady operators of our office have forwarded to her a full line of wearing apparel, and both they and she will, no doubt, derive much satisfaction from this timely [illegible]."

The whole corps of Western Union telegraph operators were lost at Johnstown. The following is related of the heroism of the chief operator: As additional particulars of the great flood are learned the story of the great disaster will undoubtedly be glorified by numerous instances of heroism and self sacrifice, [illegible] upon the roll of honor will be [illegible] name of Mrs. H. M. Ogle, the brave telegraph operator who stood loyally at her post [illegible] was literally swept away to her death. For twenty-five years she had been stationed at Johnstown, and was well known as a skillful operator and an estimable woman. [illegible] of the impending peril, indeed, with the [illegible]

water already ringing in her ears, she refused to make even an effort to escape, but, sitting calmly by her instrument, sent words of warning flying to those in danger in the valley below. When every station in the path of the terrible torrent had been warned, she knew that her work was done, and, with the water invading her room, wired her companion at South Fork, 'This is my last message."

It was indeed her last message on earth. The waters rose above her, and a brave life was ended, but not before she had accomplished the supreme act of self-devotion, and won for herself a fame which should be as undying as the history of the awful calamity with which it is connected.

Thanks to the messages of this heroic woman, hundreds of people were enabled to escape to places of safety, and what better inscription can be placed on the tablet which should be erected to her memory than this: "Others she saved; herself she could not save."

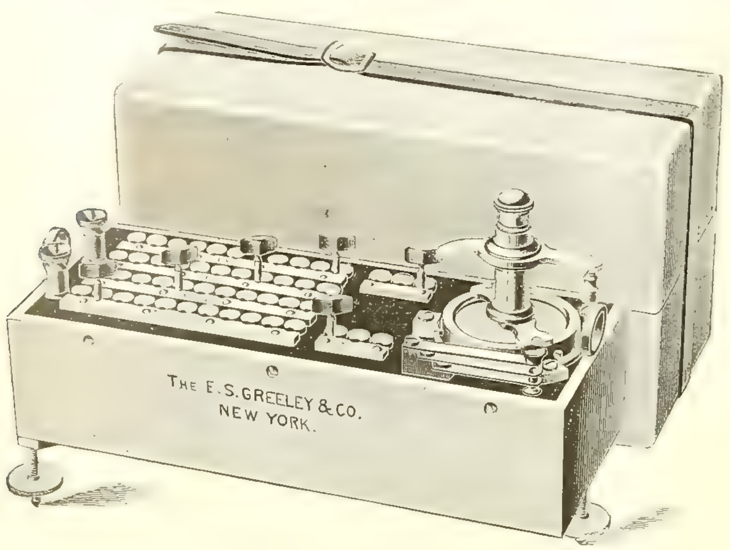
Electric Lighting on Lake Steamers

The Detroit and Cleveland Steam Navigation company, which has established a line between Chicago and St. Joseph, Mich., this season, has introduced electric lighting on rather an extensive scale. In the steamer City of Detroit, which operates between the points named, there is a plant of 325 lights' capacity, although but 280 are now operated. Two incandescent dynamos, driven by two 40 horse power Ball engines, constitute the power plant. The machines are of the latest Brush pattern, with wide armatures, open coils, and are compound wound. It is claimed that in this new type the internal resistance is decreased, thereby increasing the capacity of the machines. One machine is rated at 100 lights, though it has carried 125 without flickering. The other is a 225 light machine. As the boat was constructed some time before the plant was introduced, and no provision had been made for wiring, considerable difficulty was experienced in this part of the work. For instance, it was necessary to bore through the iron girders, which was no easy task. The wiring in [illegible] reflected great credit [illegible]. The moulding system [illegible] admirably executed. [illegible] the cabin, [illegible] the effect is [illegible] the dim [illegible]. Each stateroom is sup[illegible] [illegible] are turned [illegible]

[illegible]

Wheatstone Bridge Set.

The accompanying cut illustrates a Wheatstone bridge set which had its origin in the suggestions of C. E. Birdsall of New York, formerly electrician of the Edison company, who devised the particular means of suspending and releasing the needle. The delicacy of action secured through the fiber suspension in this instance is so great as to obtain a strong deflection through 1.1 megohm with five cells of Leclanche battery.



WHEATSTONE BRIDGE SET.

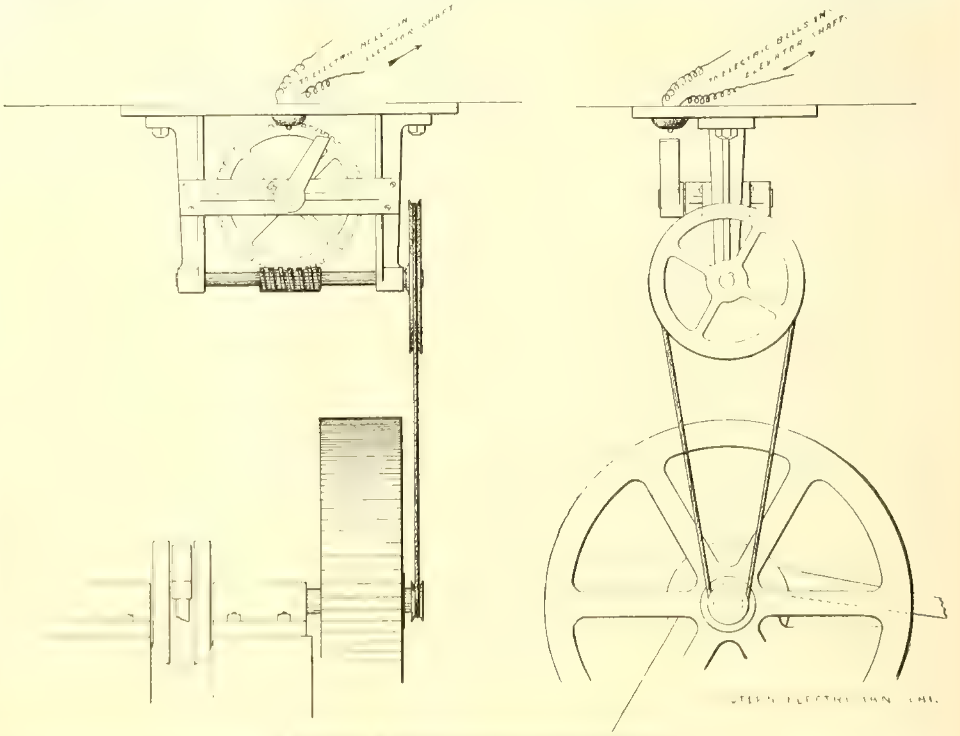
The apparatus can be used without removal from the case when it is not essential to level it, and when it is necessary to level it, it can be readily lifted out, as shown in the illustration, and leveled up with the screws provided for that purpose. A revolving galvanometer and a variable and removable dampening and directing magnet conduces to the rapidity and the ease with which work is done with the set. The act of closing the case automatically releases the fiber from all tension, and thus avoids much of the risk of rupture in transportation, and guards against neglect to make the release intentionally. The resistance coils are calibrated accurately, and arranged in four rows of ten coils each, under the designation of units, tens, hundreds and thousands. There are 10 one hundred and one thousand ohm coils on each arm of the bridge, thus giving an extreme range measurement of [illegible] ohms. The ar[illegible] such that six plugs [illegible] one in each arm of [illegible] row of the coils, [illegible] simplest possible. For example, if A = 100 and B = 10, it is necessary to plug 5 in the thousands, 0 in the hundreds, 7 in the tens and 2 in the units row; the resistance measured is equal to 507.2, a method that can hardly be surpassed in readiness and simplicity. The revolving galvanometer can at any time be so turned as to bring the needle to the zero line without altering the position of the case. The set is manufactured by the E. S. Greeley company, New York.

Electric Signaling Device for Elevators.

In some of the larger office buildings in which two passenger elevators are in constant service, running side by side, an observer will notice the efforts on the part of the conductors to make their trips as regularly as possible One tries to start his car from the top at the moment that the other commences an upward trip, both endeavoring to reach their destinations, at the top or bottom of the shafts at the same time.

The accompanying cut represents a novel device now in use in a large office building in Chicago which might be aptly described as an "elevator dispatcher." By its action the men in charge of the elevators receive, at proper intervals, signals which enable them both to start at the same time on upward and downward journeys. The design is that of W. F. O'Brien.

The dispatcher is located in the engine room of the building and is attached to, and driven by a cord from the main shaft of a high speed engine which runs constantly during the day. The mechanism is substantially as shown in cut. A grooved pulley of suitable size, fastened on the end of the main shaft of the engine, drives a worm gearing located just above the engine. On the same shaft with the gear is fixed an arm with a beveled end. This arm, once in every revolution, actuates a push button which in turn closes the circuit through two electric bells located in the elevator shafts—one at the top of a shaft, the other at the bottom. Through this little machine the men receive signals every forty-five seconds,



ELECTRIC SIGNALING DEVICE FOR ELEVATORS.

and are thus enabled to make their trips with great regularity.

Libby Prison Plant.

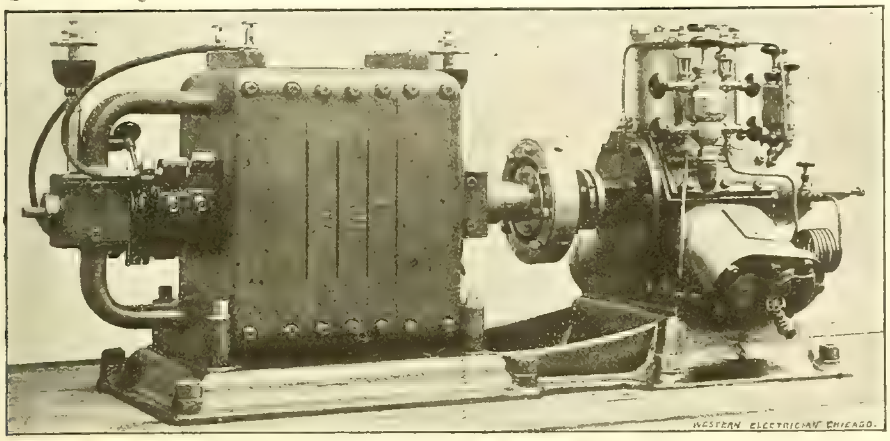
The old Libby Prison, of Richmond, which, a short time ago, was purchased by a syndicate of Chicago's citizens, is now being rebuilt for exhibition purposes on Wabash avenue, and will be lighted by electricity. Both the arc and incandescent systems are to be used. Grace Protestant Episcopal Church situated on an adjoining lot will, in all probability, be wired for incandescent lights, and take the current from the Libby Prison plant.

Advance in Electric Train Lighting.

The lighting of the Montezuma special train by electricity generated from an Eickemeyer dynamo and Brotherhood engine shows the advancement that is being made in this special department of electric lighting. The initial trip of this train, which carried President Diaz and the members of his cabinet, was made in the month of February. The officials expressed great interest in the novel electric lighting appliances. The dynamo and engine are the latest perfected appliances of the Eickmeyer dynamo and Brotherhood engine. In both Japan and China there are expected to be made installations in trains for the inspection of the officials. The plant herewith illustrated is specially adapted to this class of work, as it is compact, durable, efficient, and is not affected by the jarring motion of the train. The engine cylinders are four inches by three inches, and the entire bed plate occupies but very little space. The dynamo is rated at 80 amperes and 80 volts.

Similar plants are in use on the Pennsylvania road, the Santa Fe, the Chicago, Milwaukee & St. Paul; all the Pullman cars are now wired for lighting by this system, and the general traveling public have come to look upon electricity for train lighting as a necessity. In connection with the Eickemeyer dynamo and Brotherhood engine the storage battery is used. These are generally arranged under the cars in boxes specially prepared for them, and are charged from the dynamo in the baggage car.

On the "Pennsylvania Limited," in addition to an Ayrton & Perry ammeter and voltmeter, there is connected directly to the dynamo spindle a tachometer or speed measurer, made by Schaeffer & Budenberg, Buckan, Magdeburg.



ELECTRIC TRAIN LIGHTING.

Auditorium Electric Plant.

Work on the Chicago Auditorium electric light and power installation is progressing. The portion of the building devoted to offices is now being lighted temporarily. The wiring in the hotel is finished, and that in the Auditorium proper is nearly completed. The entire building will be illuminated by 10,000 lights. In testing the 166 circuits in the office building only six proved defective, and these measured quite high as compared with the standard of 200,000 ohms insulation resistance. The motors are on the ground and are being installed.

The Johnstown Sufferers.

In view of the recent terrible disaster at Johnstown, Pa., and in accordance with a resolution adopted at a mass meeting of Chicago citizens, a committee was formed on June 4th to represent the electrical industries of Chicago in soliciting subscriptions for the sufferers. The following named gentlemen were organized into a committee and authorized to receive funds: Geo. A. McKinlock, Chas. I. Page, B. E. Sunny, C. A. Brown, H. Ward Leonard, and J. M. Jackson. The committee's efforts were highly successful, and nearly $1,500 have already been subscribed.

The Columbia, Tenn., Electric Light company, recently incorporated, is erecting its plant for fifty 2,000-candle power arc and 600 incandescent lights.

Future of the Accumulator.

A pro[illegible] electrical man, [illegible] was [illegible]ing the [illegible] of storage batteries, [illegible] into a prophetic vein.

"The accumulator," he said, "while yet in its infancy and more or less crude, has found a place in certain lines of work. Quite a number of stations might be named where these batteries are charged during the day and used at night, either to assist or, in some cases, to take the place of the dynamo.

"Potter Palmer, for instance, has in his palatial residence in Chicago a plant where the accumulator plays a most important part, in that it offers means for running all the machinery of his lighting plant in the daytime only. No attendant is required to be on hand to look after a machine which may not be called upon to furnish a single light between midnight and morning. It has always been a matter of wonder to me why more incandescent stations have not adopted—or at least made some effort to adopt—accumulators to fill the same office as does the huge gas-holder which plays so important a part in the modern gas works.

"In comparing the cost of producing the incandescent light with that of gas, see what an advantage the gas men have in being able to run their works and make gas during the day as well as the night. Is it not worthy of the most careful consideration—this question of combining the accumulator system with that of direct incandescent lighting from dynamos?

"We may talk also about our electrical friends on the other side of the water, how slow, and how little progress they make in electrical work, as compared with that made in the States, etc. Nevertheless, these same people are getting ahead of us on the storage question. Not to mention those eminent scientists of the Old World, who have done the great bulk of the work in this line, look at the efforts being made to adapt the accumulator to road vehicles. Here are we, in this great city, with electric light stations all about us, and streets as level as a billiard table. Why does not some enterprising genius take this problem in hand?

"Such a dog cart as was built a short time ago for the sultan of Turkey—would not this be a practical machine for just such a city as this? The whole affair was quite simple. A one-horse motor was geared directly to the carriage wheel, with the batteries snugly stowed away under the seats. It was claimed that a speed of 10 miles an hour was developed and could be maintained for 5 hours. Imagine 'storing stations' located all through the residence portion of the city as well as in the business portion, and our citizens, instead of owning a horse and carriage, using electrical vehicles. What would be prettier than telephoning for your electric cart and having it brought, already charged, for a run of 5 hours?

"It may be claimed that all this will be too expensive to be practicable. All this, however, was just what was said concerning the electric light and the motor. Look at these to-day. It may seem visionary, but I'll risk making the prophecy that you and I, if we live another twenty years, will see electric dog carts and tri-

[illegible] ful as those n[illegible]

Influence of the Density of the Acidulated Water in an Accumulator.

That the density of the acid solution in an [illegible] pacity.

In the earlier days of the storage battery, M. Planté [illegible] per cent. sulphuric acid; in present use there [illegible] frequently as high as 15 to 25 per cent. used. [illegible] which gives maximum capacity.

Prof. Heim, of the Electro-Technical Institute at Hanover, has set this question at rest by a series of exhaustive measurements on two types of accumulator, the Tudor and the Electric Power Storage company's cells, under technically equivalent conditions. The Tudor accumulator was filled with 2.73 cubic decimeters of 15 per cent. acid solution (by weight), the E. P. S. accumulator with 2.3 cubic decimeters. The capacity was 53.7 ampere-hours for the former, and 50.8 ampere-hours for the latter. There appears therefore, a proportion of 50.8 cubic centimeters of liquid per ampere-hour in the first case, and 45.3 cubic centimeters in the second. These figures correspond closely enough with theoretical data.

In order to judge of the influence of the density of the acid solution, this was increased by steps of 5 per cent. each from 10 to 35 per cent., a series of charges and discharges being taken with each increment, with an average interval of 15 to 18 hours between charge and discharge. The current was kept constant by a resistance in circuit. The charging was carried on until the disengagement of gas was abundant. The discharge was stopped at a 10 per cent. fall or "drop" of the electromotive force from its initial value.

The appended tables give the results expressed as averages of several experiments that were concordant within one-half per cent. for the voltage and within 3 per cent. for capacity. The figures are concordant for both accumulators.

TUDOR ACCUMULATOR.

Density of the liquid before charging at 15° C	1,06[illegible]	1,0[illegible]7	1,1[illegible]	1,1[illegible]	[illegible]	1,261
H_2SO_4 per cent. by weight	10.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E. m. f. at commencement of discharge volts	[illegible]	1,[illegible]8	2,02[illegible]	[illegible]	[illegible]	2,145
Terminal potential difference in volts	1,023	1,[illegible]45	[illegible]	[illegible]	[illegible]	[illegible]
Discharge capacity in ampere hours	[illegible]	53	[illegible]	[illegible]	[illegible]	32.8
Electric energy in watt-hours	[illegible]	102.2	[illegible]	97.2	[illegible]	[illegible]
Charge in ampere hours	[illegible]	55.5	[illegible]	[illegible]	[illegible]	[illegible]
Electric energy expended in charge in watt-hours	10[illegible].7	11[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Efficiency by quantity per cent	[illegible]	96.9	[illegible]	96.5	[illegible]	[illegible]
Efficiency by energy per cent	[illegible]	87.8	[illegible]	[illegible]	[illegible]	[illegible]
Density of liquid after the charge at 15° C	1,10[illegible]	1,14[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

E. P. S. ACCUMULATOR.

Density of the liquid before charging at 15° C	[illegible]	1,1[illegible]	1,13	1,1[illegible]	[illegible]
H_2SO_4 per cent	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E. m. f. at the commencement of discharge, volts	1,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Terminal potential difference in volts	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Capacity in ampere hours	40[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Electric energy in watt hours	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Density of the liquid after the charge at 15° C	1,11[illegible]	1,14	[illegible]	[illegible]	[illegible]

The curves that can be produced by plotting these figures show that the difference of potential increases in proportion to the density of the acidulated water. It is noticeable that while the curve of the difference of potential indicates nothing remarkable, the specific resistance of the liquid varies greatly, another proof that the internal resistance of an accumulator depends for the most part on the surface of the plates and very little upon the liquid. The figures obtained also show that the capacity rapidly increases, as the strength of the acid is increased, from 10 to 14 per cent., attaining a maximum between 15 and 16 per cent., and subsequently decreasing as the strength of the acid exceeds

these values. The maximum electrical energy occurs at a little above 16 per cent.

With 25 per cent. of acid the appearance of the plates, the positives especially, was not as good as with liquid of lower density, and above 20 per cent. the capacity had noticeably diminished. Wishing to ascertain the cause of this diminution, Professor Heim made the following experiments: The E. P. S. accumulator, after three charges and successive discharges with water acidulated to 30 per cent., at which the capacity had been 28.5 ampere-hours, was refilled with liquid of 13.5 per cent. But as the plates were still impregnated with the liquid of the preceding experiment, the density was raised thereby to 1.114, corresponding to 16 per cent. The first two trials gave a capacity of 39.8 ampere hours instead of 50 ampere-hours, previ-

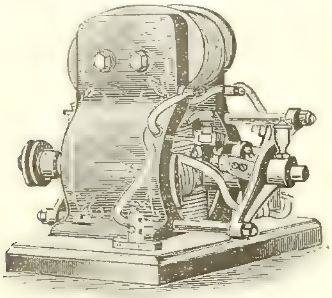


FIG. 2. RHODES MOTOR.

ously obtained. The cells were then charged for a long time with about 210 ampere-hours, and after two charges and discharges the capacity returned to its previous value. Similar trials with the Tudor accumulator gave like results. Professor Heim explains these facts by the concentrated acid giving rise to a large quantity of sulphate of lead, which diminished the capacity. After a long charge, and with a liquid weaker in acid, all this sulphate is reduced, and the capacity is found at its original value.

Finally Professor Heim makes a very important remark. An accumulator filled with acid of 9.6 per cent. (1.064 sp. gr.) before charging had a capacity of 51.8 ampere-hours, an increase of 7.9 ampere-hours or 15.3 per cent. for a difference of acid strength of 6.4 per cent.

The writer, who has abstracted these points from Professor Heim's very much more elaborate paper, has confirmed the deductions for several other types of "pasted-plate" battery; but from a series of experiments with a well-formed Plante cell the writer has arrived at the conclusion that the strength of solution recommended by M. Plante should not be discarded. In fact, he finds that above 13 per cent. of acid the capacity can be said to diminish in the case of a plain lead Plante cell, and that about or between 9 to 10 per cent. gives the maximum capacity. There is, however, the difficulty in these trials of obtaining a fully formed cell. But returning to a higher percentage of acid after using a 10 per cent. solution appears, in the case of a plain lead Plante cell, to noticeably reduce the capacity.

Electric Light Litigation.

The Fort Wayne Jenney Electric Light company [illegible] Indianapolis against the Evansville Gas and Electric Light company charging infringement of patent. The defendant is operating the Westinghouse system and [illegible] against the [illegible] that this is but [illegible]

[illegible] Judge Gresham in the [illegible] Piney [illegible] gave [illegible] The defendant operated a Jenney plant and the com- [illegible] Gresham's opinion [illegible] own in the pat- [illegible] the invention which was there described, [illegible]

dedicated to the public by acquiescence in the ruling of the examiner, and cannot be claimed in a subsequent patent against others who meantime entered the field and used the rejected invention.

"The patent in suit is limited to solenoids and cores mechanically opposed, and it does not include the common or electro-magnet, and thus construed the patent sued on is not infringed by the defendants."

Electric Lights for Train House.

The Wisconsin Central Railroad company's immense train house now in course of construction between Harrison and Polk streets and west of Fifth avenue, will have one of the most elaborate electric light plants in use in railroading. The train house itself is 560 feet long, 120 feet wide, and 90 feet high. East of this train house, along Fifth avenue, will be the offices, waiting rooms, baggage rooms, etc., and this building will also be lighted by electricity. The plant will be placed under the main building. The system to be used has not yet been decided upon. Both arc and incandescent lights will be used. At present it is intended to arrange a row of incandescent lamps around the building just beneath the roof with a strong reflector behind them. In the center of the train house arc lamps will be suspended. In the waiting rooms and baggage rooms, and at the entrances, arc lamps will be used, and incandescent lamps utilized in the offices throughout the building.

The Rhodes Motor

The accompanying cuts show the two forms of a motor designed by Charles M. Rhodes of Philadelphia. The smaller size is represented in Fig. 1 driving a circular exhaust fan. The little machine is quite compact, and so cased in as to be practically dust tight. This pattern is well adapted to driving sewing machines, small fans, and such light machinery.

The larger form, Fig. 2, is built with a view of its being applied to heavier work. As will be seen by the cut, the peculiarity of this larger size lies in the fact that it has but one field magnet. The four-poled armature revolves between vertically-set pole pieces, these pole pieces being united to, and conveying the lines of force from, the two poles of the one horizontal field in such manner as to complete the magnetic circuit through the armature.

By this arrangement both poles of the one field are utilized. While grooved pulleys are shown in the illustrations, the machine is fitted also with flat-faced pulleys.

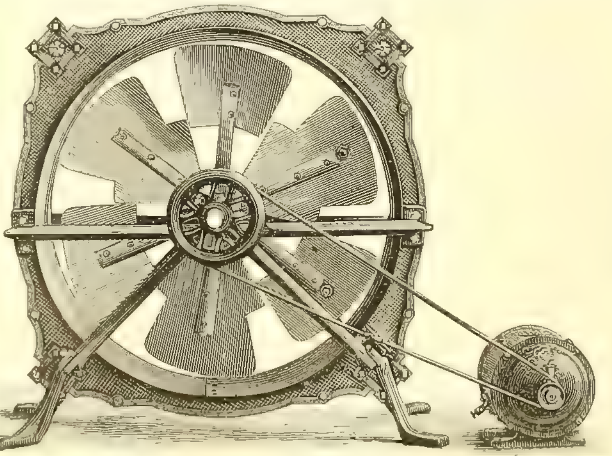


FIG. 1. RHODES MOTOR

Chicago City Electric Light Plant.

Prof. Barrett, city electrician of Chicago, started on a tour of inspection last week with a view of ascertaining the advantages of several devices and machines recently introduced in electric lighting. For this purpose he will visit Rochester, N. Y., Cleveland, O., Detroit, Mich., and [illegible] other points. Prof Barrett intends to have the latest improvements in machinery [illegible] object in visiting the [illegible] these devices where they [illegible] operation. Before leaving Chicago

he awarded the contract for 75,000 feet of 2-inch wrought iron pipe, dipped in asphaltum to Sam I. Pope & Co., Chicago, whose bid was 9.48 cents per foot. The Riverside Iron Works of Wheeling, W. Va., were awarded the contract for 50,000 feet of 2-inch steel pipe at 9.48 cents per foot.

Electricity Produced by Wind Power.

In the course of an article on producing electricity by wind power, the London *Electrical Review* speaks of an installation in France at the extremity of the Cap de la Heve, which is about two miles distant from Havre. Electricity is employed as the lighthouse illuminant, and at the time of the putting up of the installation it was resolved to endeavor to utilize the motive power of the wind for driving dynamos. Accordingly, a windmill or "wind motor" as it is termed, of the modified Halladay type, was erected, and it develops about 18 horse power when the wind is blowing at the rate of 33 feet per second. The wind motor, which is mounted upon a wooden framework fixed upon blocks of masonry, imparts motion, by means of a vertical shaft and conical gearing, to a horizontal shaft placed at a suitable distance from the ground. On the horizontal shaft are mounted two pulleys which, by means of belting, drive two dynamos of different sizes which are connected to a series of accumulators. The speed of the wind-motor is automatically regulated by an apparatus which opens or closes the sails according to the velocity of the wind. The intensity of the current of the smaller dynamo is 8 amperes when the latter is running at 100 revolutions per minute, and 40 amperes when the speed is 260 revolutions; whilst the larger dynamo gives a current of from 40 to 100 amperes for a speed of from 250 to 650 revolutions. The mechanical efficiency is 4 horse power for the small and from 4 horse power to 6 horse power for the large dynamo. The dynamos are run alternately, according to the quantity of energy stored in the accumulators.

It will be seen from the foregoing that this installation is certainly unique in character. It was put up some time ago as an experiment, and has answered the expectations of those concerned. That this should be the case is not surprising, when we consider the fact that the installation is on a small scale, but what would happen if a proportionate success could be obtained in central stations, say, of the size of that at the Grosvenor Gallery, or that in course of construction at Deptford? Would not the directors of our electric lighting companies rub their hands and dance for joy at this El Dorado—at being able to dispense with steam engines and boilers, which decrease in initial cost would enable them to supply light probably at the same price or even cheaper than gas?

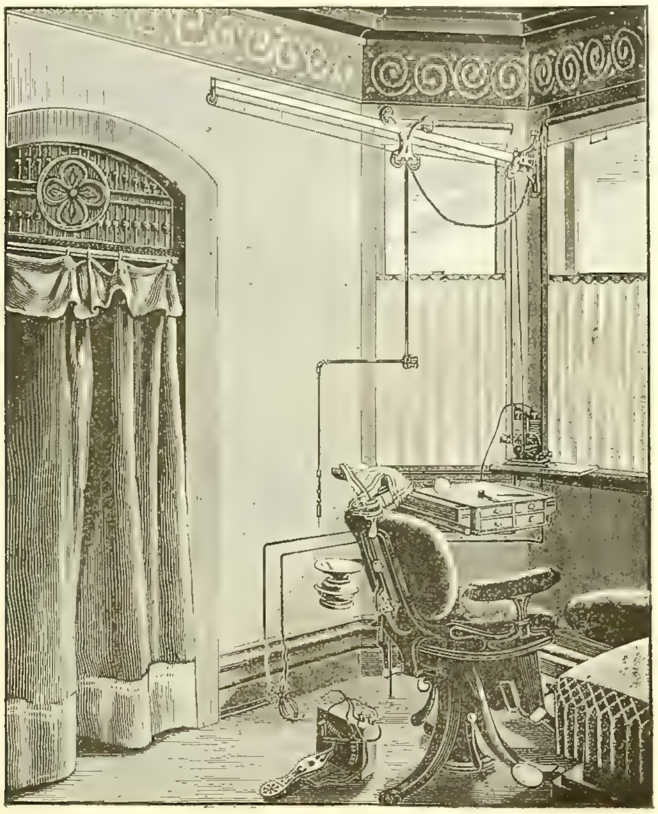
It is to be regretted that such a fanciful dream cannot be realized, for the simple reason that there are three serious objections to the use of windmills for driving dynamos. In the first place there are the periods of calm, during which no movement of wind appears to take place; in the second place, the irregular velocity of the wind; and in the third place, the imperfect construction of the receivers or windmills It is quite manifest that the first objection is insurmountable. The second has partly been overcome in the instance described above, by the employment of an automatic apparatus which opens or closes the sails according to the velocity of the wind; but how far such an arrangement could be used on a large scale we will not venture to predict. The last objection is, doubtless, one which might be surmounted; but the impossibility of overcoming the first objection and the indefiniteness of the second, are sufficient proofs to show that the wind will never be utilized on an extensive scale for motive power purposes, and especially as regards electric lighting.

It is astounding to note how completely we are passing under the power and becoming dependent on the applications of electricity, remarks the *Furniture Gazette*. All cities of size are lighted by electric contrivances, and electric motors do a vast amount of work that steam was used for until within ten years. Within a very short time we shall surely have all our villages, and even country houses, lighted and warmed by electric applications, and it is to be hoped that a motor will be devised applicable to country carts and carriages. The latest application of electricity is to the piano, securing complex results understood by musicians, but never before attainable. And yet we scarcely know what electricity is, or have any full idea of its versatile nature.

Electrical Dental Engine.

The accompanying cut represents the interior of a dental office, furnished with the electrical dental appliances, manufactured by the Electrical Construction company of Chicago. The dental engine is the invention of Dr George W. Whitefield. The device consists of an electric motor operated by primary batteries, storage batteries, or dynamic currents, and an appliance for breaking the current which will stop instantaneously a machine making 2,[illegible] revolutions per minute. This device consists of a soft iron wheel revolving in front of the poles of an electro-magnet and a switch operated by the foot.

It is scarcely necessary to dwell on the many advantages to be derived from the operation of dental machines by electricity, as their superiority over the old style of machines is acknowledged by the members of the profession. The desirability of high speed in this work is also conceded, and this can only be obtained by the use of electrical energy. Moreover, the speed is uniform, and therefore the operation less painful to the patient. The speed can be regulated by a rheostat operated by a portable treadle.



ELECTRICAL DENTAL ENGINE.

The machine illustrated was exhibited at a recent meeting of the Illinois Dental association, and was commended by all who witnessed its operation.

Alternate Current Working.[1]

PART I.

BY W. M. MORDEY.

I wish to state at the commencement that this paper is not intended as a contribution to the comparison of the relative merits of alternating current working, and of any system of direct current supply. The discussion of this question has already taken place, and those who took the alternating current side have no reason to be dissatisfied with the result. It may, however, be pointed out that exclusive advocacy of any one particular method of working, as being the best for all purposes, is not a position that is likely to be taken by any electrical engineer who has any extensive acquaintance with the various requirements and conditions that are met with in practice.

WORKING ALTERNATORS PARALLEL, AND BEST PRINCIPLES OF CONSTRUCTION FOR ALTERNATORS.

This is a matter of very great scientific interest, and of still greater practical importance. It is not too much to say that the complete success of the transformer system of supply depends to a great extent upon whether alternators can be quite easily and successfully worked parallel. This has been strongly insisted upon, especially by the opponents of that system. The importance attached to it arises partly from the fact that the most economical method of [illegible] that of using [illegible] the [illegible] plant [illegible] work, and increasing or [illegible] the [illegible] generating units in operation, according to the [illegible] of the demand. To do this most conveniently, the alternators should be worked parallel, and ought to be capable of being put in and out of [illegible] easily, and without causing even a momentary [illegible] interruption of the light. The use of a large machine and engine for the [illegible] day supply is especially to be avoided. In [illegible] it is desirable to have a [illegible] small set of plant for this work, even where large machines are used for the heavy evening work.

Another argument in favor of parallel working, as against the use of very large machines, is that it reduces the cost of the spare plant. Thus, if a station is provided with one or two machines and engines for the full load, the spare plant is equal in cost to the working plant, or, perhaps, to one-half as much. If, however, smaller generating units are employed, one set in four may be considered a safe [illegible].

The history of parallel working of alternators may be briefly sketched.

In 18[illegible] Wilde described parallel working and synchronous action of generators, and so nearly obtained synchronous motor action that it is extraordinary he should have missed it.

In 1882–3 Dr. Hopkinson, not knowing of Wilde's work, arrived theoretically at the conclusion that it was possible to work alternators parallel, but not in series, and subsequently demonstrated the fact that by trials made, in conjunction with Prof. Adams, on the De Meritens machines at the South Foreland Lighthouse, which were run parallel and as motors. This was all laid before this society at the time, and was very fully discussed.

In the course of this discussion in 1884, Mr. Alexander Siemens described some experiments showing that the Siemens alternate current machine ran as a motor. This is interesting as being, so far as I know, the only recorded instance of an alternator without iron in the armature being run as a motor. It will be remembered that the Wilde and De Meritens machines had iron cores. These experiments of Mr. Siemens were not very successful, the motor frequently stopping suddenly, even when doing very little work; but they were of value for comparative purposes.

Passing over the next few years, we find that the use of alternators had become of great importance on account of the growth and development of the transformer method of distribution, and that there was and is a certain amount of doubt and hesitation about working parallel. It is recognized that it has been and can be accomplished, but that the arrangement is not one to be thoroughly and completely depended upon in every case. And there is sufficient justification for this doubtfulness. The present opinion may be fairly stated as follows: Alternators may be successfully run in parallel if they have a good deal of self-induction, and to secure this it is better that they should have iron-cored armatures.

In his recent paper on "Alternate Current Machinery," before the Institute of Civil Engineers, Mr. Kapp dealt at considerable length with this part of the subject, and his views, I need not say, may be accepted as quite correctly representing the current state of knowledge and opinion. Referring to alternators that have self-induction negligible, Mr. Kapp says: "Machines of this type can only be run in parallel if the strength of their field is adjusted with [illegible]

cored armatures, and then with different [illegible]

Now [illegible] means, if true, that the only machines suitable for central station [illegible] self-induction and resistance, are bad regulators, that will [illegible] a good deal in electromotive force, and that are wasteful on open circuit.

For my part, I have seen enough of the use of iron in armatures to wish to do without it if I can, and I have repeatedly pointed out that, if iron is really necessary, the armature is the very worst place to put it [illegible] of increasing the self-induction, it can be much better used outside of the machine, and put in some place where it is not subject to all the losses, restrictions, and disadvantages that necessarily accompany its employment in the core of an armature. If it is not in the armature, it can be entirely removed when not required for the purpose for which it is thought to be necessary—that is, when [illegible] is in use. To put iron into an armature [illegible] to increase self-induction, appears to show a [illegible] of common [illegible]ity and an absence of the sense of proportion.

In the first place it will be found that the use of iron armatures is not in all cases to be relied on to give successful parallel working.

A little elucidation, perhaps, is necessary here—"Many of us have tried them, and they will on trial, work together, no doubt, but they do not work together till they have run for three or four minutes. They will in that time jump, and that jumping will take months of life out of the 40,000 lamps. That alone is rather a serious difficulty in coupling machines together, and I think we may take it in practice—I am not speaking about the laboratory or experiments—that we do not couple machines."

The Zipernowski alternator will, however, work parallel, but apparently not very well. To get it to do so, the periodicity has had to be reduced to 42, as we now know.

Further, I have recently seen a communication from the highly experienced makers of a well known alternator in which iron is used, stating that, if it is desired to run parallel, the machines, engines, and arrangements must be in every way identical, the impression conveyed being that with this machine the greatest care is necessary.

Then, again, the large experience of the Westinghouse company in the United States has shown that their iron-cored alternators will work in parallel under some conditions. We are told that, with these machines, 'parallel coupling always succeeds when they are loaded to about half their maximum output or over, but that machines working under a less load cannot with certainty be so coupled."

But the other day Professor Forbes described successful parallel working with the iron cored Lowrie-Parker alternators at West Brompton, even with very light loads.

Thus it will be seen that we have evidence ranging from complete failure to complete success with iron-cored machines.

It is proved, then, that the presence of iron is not alone sufficient to insure success, for the use of iron is associated equally with failure and with success

That the success attained is complete only as regards the fact of synchronism, is shown by the following extract from Prof Forbes' remarks in the discussion on Mr. Kapp's paper.

The passage is: "The question of parallel working was one which had been very much discussed as to whether it was desirable or possible. [illegible] It was always possible, as Mr. Kapp said, with machines which had a very high self-induction — machines in which the armature had a great mass of iron in it. At the same time [illegible] tion of that self-induction [illegible] Mr. Kapp [illegible] the plant efficiency [illegible] chine, and if they could work [illegible] would work out some better means of [illegible] machines work in parallel, it would be very [illegible]

"Another reason why the [illegible] was [illegible] jurious, was that it received such [illegible] the part of those in the station to see that [illegible] was maintained constant. The [illegible] so much that the quantity of current [illegible] was seriously affected, and constant [illegible] keep such a machine [illegible] whereas a [illegible] little [illegible] whatever the [illegible] maintained [illegible]

[illegible]

¹Read before the London Institute of Electrical Engineers.

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THE *Railroad Gazette* says a fair statement of various systems of car lighting now in use would place electricity first in the list in point of safety.

The terrible conflagration which destroyed property to the value of $7,000,000 in Seattle caused the destruction of the electric light plant, the electric railway power house, and the general telegraph office.

DR. LEONARD PAGET'S article on the "Influence of the Density of the Acidulated Water in an Accumulator," which appears in this issue, [illegible] interest to those concerned in [illegible] lts from storage batteries. The writer concludes that Plante's solution, which contained 10 per cent. of acid, gives the [illegible] 15 per cent. of [illegible]

THE Illinois legislature has adjourned, after a [illegible] several [illegible] ed for the regulation of [illegible] tion of the term. The bills were designed to strike a blow at the telephone interests, and especially at the Chicago company. Had they passed the companies would have been unable to continue business. It is not surprising, then, that the bills which caused so much bitter feeling in the legislature failed to pass.

ELECTRICAL inventions have become such commonplace affairs that the extraordinary part which they play even in a great crisis scarcely attracts attention. The appalling calamity at Johnstown was made less terrible than it would have been had not the telegraph operators, though urged to fly to the hills, remained at their posts of duty and continued to send by wire warnings of impending danger to those who lived in the valley below. The entire telegraph force was drowned. When every station had been warned the operator in charge of the office wired, "This is my last message." A moment later she was borne away by the flood. The work of the operators who made known to the world the needs of the stricken inhabitants was in a number of instances scarcely less heroic. When night came upon the ruined city, after the search for bodies had commenced, it was an electrical engineer who mounted a dynamo upon a car, organized a temporary plant, and was thus able to provide a considerable portion of the city with light which served a double purpose. The illumination made more hazardous the robbing of the bodies of the dead by ghouls, and made it possible to continue the search for the missing.

THE bill passed by the Illinois legislature giving to horse car and dummy railway companies the right to substitute an electric motor or cable system for the existing mode of propulsion, has been vetoed by Governor Fifer. The governor yielded to the pressure brought to bear upon him by municipal authorities, who protested that they should be consulted when a street railway company desired to make a change of motive power. Had no mention been made in the bill of the cable system, the measure would have had a better chance of securing public approval. Unquestionably a strong public sentiment exists against a multiplication of cable systems. The failure of the cable road on the North side in Chicago is to a great extent responsible for the opposition to the system. The governor holds in his veto that if it is wise to require street railway companies to procure the consent of the property owners and of local municipal bodies before constructing their roads in the first instance, it is wise also to require such consent to change the particular kind of motive power to be employed. There is no sound reason, he thinks, for distinction. The city and property owners might consider cars moved by horse power safe and no damage to property, while cars moved by cable, steam or electric motors might be unsafe, and might impair property values. At least, the people and the local authorities have a right to pass on the question. In elaborating this argument he adds: "The nearer such questions can be brought to the sound judgment of those who are locally most concerned, the better, in my judgment, the law is; and the fact that an appeal is thought necessary from local authorities to a distant legislative body to grant this sweeping general power to street railway corporations is itself the strongest evidence that the bill ought never to have passed. In my judgment the principle of the bill is vicious, as taking an important power from the people and investing it in corporations."

DURING the last few weeks the question of crossing the Atlantic in five days or less has been discussed at considerable length in the daily papers. The topic invariably comes to the front whenever the record is broken by a new steamer. The City of Paris' feat of making the trip in five days, twenty-three hours and seven minutes has made its chief engineer, Ernest Gearing, a [illegible] in shipping circles. He has written a communication which has appeared in the daily papers on the difficulty of further reducing the time. He refers to the [illegible] batteries to furnish [illegible] steamer. Vague articles [illegible] written by persons entirely innocent of electrical knowledge appear at intervals containing predictions that the time will soon come when electrical energy will be utilized for the propulsion of ocean steamers. How the application is to be made neither they nor their readers have the faintest conceptions. The most sanguine electrical engineer will probably have no greater confidence than Mr. Gearing in the immediate solution of the problem. He says:

"I do not think that electricity will ever form the motive power for fast vessels. On a five-day boat you want propelling power first hand. That being the case, what would be the sense in first producing steam to operate a dynamo, and in turn operating the dynamo to secure the propelling power? It would be a roundabout way of gathering power. Still the day may not be far distant when electricity will be applied with success to an ocean craft. If the experiment is ever made, the electric power will have to be stored in batteries below decks, somewhere about the hull, to be drawn and used when really needed. I do not know what electric power would be required to drive a 10,000-ton vessel at the rate of twenty-four or more miles an hour, nor can I say what space this strength would occupy when stored below decks. I never saw any estimate touching this subject, and I do not think anybody has yet figured as to whether a 10,000-ton ship would be able to carry sufficient stored electricity to drive her at the high rate of speed which a five-day trip across the Atlantic would demand."

IT is now stated that the execution of Kemmler, the Buffalo murderer, sentenced to suffer death by the application of electricity, will be considerably delayed. When sentence was pronounced the prisoner's counsel took an exception on the ground that the new death penalty violated the constitution, which provides that no criminal shall suffer cruel or unusual punishment. The objection was overruled, but it is sufficient for an appeal, and even if that results unfavorably it will delay the experiment of electric capital punishment for several months. After the appeal has been filed staying the execution an application will be made to the Supreme Court at Auburn for a habeas corpus and an order providing for the investigation of the punishment to which Kemmler has been condemned. It is stated that a number of lawyers, who represent persons charged with murder, will combine their efforts to test the constitutionality of the law.

Dr. Van Der Weyde has been retained as an expert on behalf of Kemmler. He is quoted as saying: "I consent to act for Kemmler without any desire to make money, but merely because of my interest in the subject, and my belief that the law is unconstitutional. I consider it greatly to the interest of justice and the legal profession that the question be settled at the outset before any illegal judicial murder has been committed under the new law. I wish it also distinctly understood that this case is not being pushed in the interest of any other criminals, and that, contrary to the impression of some people, a decision by the Court of Appeals declaring the law unconstitutional would not result in allowing any murderer to go free. I wrote the district attorney of Buffalo county yesterday offering to co-operate with him in bringing the question to a speedy issue, and securing a decision by the Court of Appeals at this term if possible."

The legislature of Massachusetts has under consideration a change in the mode of inflicting the death penalty. A bill amending the present law has been introduced, which reads as follows: "The punishment of death shall in every case be inflicted either by hanging the convict by the neck until he is dead, or by causing to pass through his body a current of electricity of sufficient intensity to cause death, and the application of such current must be continued until the convict is dead. Such punishment of death shall be inflicted in the manner in which the judges of the court at which the conviction takes place shall determine, agreeably to the provisions of this section; and the sentence shall, at the time directed by the warrant, be executed within the walls of a prison of the county in which the conviction was had, or within the inclosed yard of the prison."

Annual Meeting of the American Institute of Electrical Engineers.

Among the papers read at the last meeting of the American Institute of Electrical Engineers were the following:

THE INHERENT DEFECTS OF LEAD SECONDARY BATTERIES.

BY DR. LOUIS DUNCAN AND H. WIEGAND.

Since the year 1881, when the inventions of Faure gave such an impetus to the industrial development of lead secondary batteries, their commercial history has been marked by numerous and disastrous failures, while at the same time there has been a steady improvement in their construction and performance, until at present they have reached a stage which makes them for some purposes a commercial success. At the same time there remain in the best batteries a number of defects which prevent their

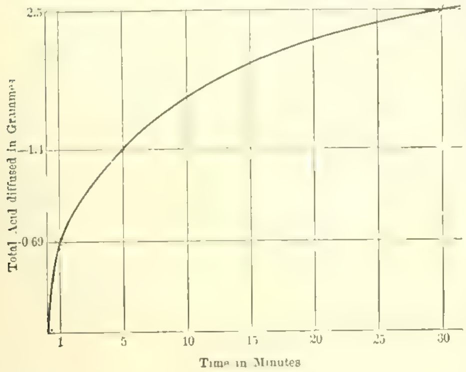

Fig. 1.

taking the place in the practical development of electricity which rightfully belongs to them. The action of the secondary battery is quite well understood. In the Faure type a support plate, usually made of lead or an alloy of lead, has mechanically applied to it some salt of lead (minium or litharge). A number of such plates are placed in dilute sulphuric acid, the alternate plates being connected respectively to the + and — poles of some source of electricity, and a current is sent between them. The result is a reduction on the positive plates (the plates through which the current enters) to PbO_2, on the negative plate to spongy lead. After this "formation" the action, roughly speaking, consists in a reduction of both peroxide and spongy lead to sulphate of lead on discharge, while on charging they are reduced again to their original composition. We find that in the process of charge and discharge there is a loss of energy varying from 15 to 40 per cent. within the practical limits of discharge rate. If we calculate the theoretical storage capacity of a given weight of lead and peroxide, we will find that the plates of even the best modern batteries weigh for the same capacity ten times as much as would those of a theoretically perfect cell. We will find, too, that there is a constant depreciation especially of the peroxide plates, the rate of depreciation increasing with the rate of discharge, and in general depending partly on the way in which the cell is treated, partly on its construction. The principal defects of the modern lead secondary battery are (1) the comparatively small storage capacity, (2) the loss of energy, (3) the depreciation, (4) the low discharge rate necessitated by considerations of efficiency and depreciation.

It was especially the question of the loss of energy in the battery that we wished first to investigate. There are two factors which determine the extent of this loss. In the first place, the number of ampere-hours obtained on the discharge of the cell is less than the number put in; and in the second place, the P. D. at the terminals is greater during charge than during discharge. This loss of energy exhibits itself in two ways—in a generation of heat, and in chemical actions which are not reversed on discharge. It is well known that after a cell has been in use for some time, especially if it be submitted to rapid charge and discharge, there will be found in the bottom of the containing vessel a white, powdery deposit, a sulphate of lead which has been formed from the active material of the plates, and which has not been afterward reversed. Again, when the cell is charged we find bubbles of gas escaping from the plates during almost the whole of the charge, the escape becoming quite violent toward the last. The escape is at first principally from the positive plate, but afterward it is from both plates. This escape represents, of course, a loss of energy due to the electrolysis of the dilute acid in the cell, the products being free hydrogen and oxygen.

Let us consider what takes place during the charge and discharge of a cell. Supposing the cell to have been discharged until its P. D. has dropped to 1.8 volts, on beginning to charge the P. D. increases until it reaches a value of about 2.1 volts—at a normal charge rate—then increasing very slowly during a considerable portion of the charge, then increasing faster until it reaches a value of from 2.4 to 2.5 volts, when the cell is "boiling." The chemical action results principally in the reduction of the sulphate of lead on the two plates to peroxide and spongy lead, respectively. The greater the charge rate the higher will be the P. D., and the sooner will the cell begin to boil, and the greater will be the loss.

On discharge the P. D. drops to from 2 to 1.95 volts for normal discharge rate, where it remains during the greater part of the discharge, there being a gradual fall during the latter part to 1.8 volts, when the discharge should cease. If a high discharge rate be employed there is a decrease in the capacity and efficiency, and a more rapid depreciation. If the discharge be continued after the P. D. has dropped below 1.8 volts, there will be a formation of white sulphate on the plates, there will be a loss of energy, as will be shown, and there will be a rapid depreciation of the cell. The result of the discharge is a formation of sulphate of lead on both positive and negative plates. If we test the specific gravity of the solution at different times we will find that the [illegible] has a maximum strength [illegible] —when fully charged, with a minimum on discharge [illegible] 1.150, the sulphating of the lead decreasing the strength of the solution. The number of ampere-hours obtained on discharge is less than the number put in, by an amount depending on the construction of the cell and the conditions of charge and discharge. There is a further apparent loss of energy in the fact that the electromotive force on discharge is less than that during charge.

Our first experiment was made to determine, if possible, whether part of this difference of e. m. f. was not due to the fact that the strength of the solution *in the plugs* varied, it being stronger during charge than during discharge. During discharge the sulphuric acid in the plugs has its strength decreased by the sulphating of the lead or peroxide. This weakening continues until the diffusion of the stronger acid in the cell produces a condition of equilibrium. It is known that the electromotive force of a cell varies with the strength of the solution, being higher as the strength increases. Gladstone and Tribe have found that when the acid is very weak the chemical action is changed, the result on a positive plate of sheet lead being the formation of streaks of a mixture of yellow and puce-colored oxides, while on other parts a white substance is formed, which is easily detached, falling in clouds into the liquid. This white substance is probably a basic sulphate of lead. When this action takes place the corrosion of the plate is more than doubled. So if the diffusion in the plug is slow, it may very well happen that there will be a great difference of density during charge and discharge, causing a difference in electromotive force and a formation on discharge of chemical compounds which are not afterward reduced. A rapid discharge rate would tend to greatly weaken the acid, and therefore to decrease the efficiency and hasten corrosion of the positive plate.

To find the rate of diffusion we soaked the plates or single plugs to be experimented on in acid of a specific gravity of 1.175, and then placed them in vessels of distilled water, letting them remain for different intervals of time, and determining the amount of acid diffused out into the water. To give some idea of the magnitude of the result, I select the following figures from a number of experiments. The plates used weighed about a pound and a half (.7 kilos.), and were of the grid type:

POSITIVE PLATE.

CHARGED.		DISCHARGED.
Time in water.	Acid diffused.	Acid diffused.
1 min.	.095 grms.	.29 grms.
5 "	1.41 "	.60 "
30 "	2.50 "	1 43 "

NEGATIVE PLATE.

CHARGED.		DISCHARGED.
Time.	Acid diffused.	Acid diffused.
1 min.	.86 grms	.317 grms.
5 "	1.42 "	.700 "
30 "	3 05 "	1.35 "

The curve shown in Fig. 1 gives the diffusion from a charged positive plate.

The total amount of acid in the charged positive plates was (25 grms. of 1.175) about 5 grms; so it will be seen that the rate of diffusion of the acid in the interior of the plugs is slow, for after thirty minutes, when half of the acid remains in the plug, the rate of diffusion has decreased from about .7 gramme for the first minute, to about .025 gramme per minute. While this is hardly the condition of affairs in actual practice where the rate at which the acid is being added or abstracted varies in different parts of the plug, yet it gives us some idea of the magnitude of the quantity. It should be noted that the rate of diffusion is materially the same for positive and negative plates, but that the rate for a discharged is considerably less than that

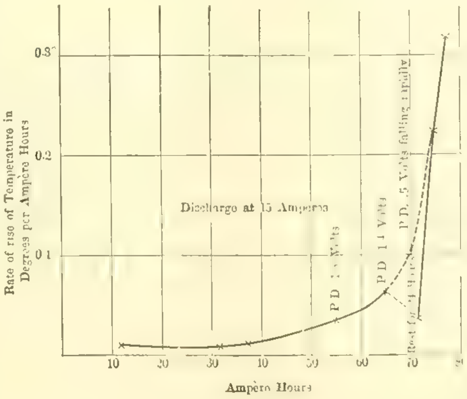

Fig. 2.

for a charged plate. Keeping these facts in mind, let us pass to the phenomena of charge and discharge.

To investigate the loss of energy from heating, we placed the cell to be experimented on in a wooden box lined with a layer of felt about an inch thick. There was a top for the box, also lined with felt, and through it passed the rod of a stirring paddle and the stem of a thermometer. Experiment showed that the loss of temperature in this arrangement was for a

Difference between air and box.	Degrees loss per degree diff. per hour.
7.2	.12
5.1	.1
4.2	.05

In the experiments we tried as nearly as possible to keep the air and cell at the same temperature, and the correc- [illegible]

[illegible]

Amp. hours discharge.	Rate of rise of temp. per amp. hour.	Total rise.	C² R.
[illegible]	.012	....	....
[illegible]	.1	....	....
[illegible]	[illegible]	....	....
[illegible]	.15	....	....
[illegible]	.13	..	....
[illegible] falling	.2	[illegible]	[illegible]
7[illegible]	.2		
77	.3[illegible]	[illegible]	[illegible]

In this case the discharge was carried [illegible] the limit of economical discharge. [illegible]

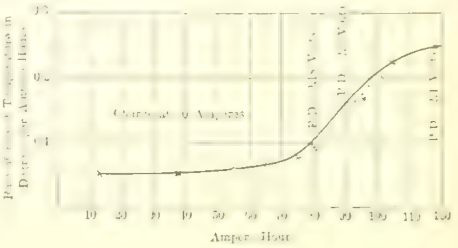

Fig. 3.

is greater as the discharge continues, increasing slowly until the e. m. f. begins to drop, when it rises very rapidly.

After this discharge the cell was charged at a rate of 10 amperes.

RATE OF RISE.

Ampere-hours.	Degrees.	Total rise.	C² R.
20	.04	. .	....
40	.04	....	....
60	.05	...	....
80	.0[illegible]	4.7	[illegible]
100	.10	8.9	...
120	.20	11.5	12

The cell thus charged was discharged at a rate of about 20 amperes. The rate of rise of temperature was very much as in the case of the discharge at 15 amperes. The total rise, with the P. D. down to 1.7 volts, 60 amperes having been taken out, was 1.1°; on further discharge down to .7 volts, taking about 20 ampere-hours more from the cell, the rise was 4.1°. This again shows that the loss increases as the P. D. falls.

The next charge was at 20 amperes. The rate of rise of temperature is given by the curve, Fig. 4. The total rise was 30.7°. The rise for 100 ampere-hours was 11.5°. The corresponding values of C² R. were 34 watts and 20 watts.

The effect of a rest is shown on the portion of the curve between 105 and 120 amperes, where a 10 hour rest gives a considerable reduction in the rate of temperature increase. The maximum rate is about .3 degree per ampere-hour.

The cell thus charged was discharged at a rate of 30 amperes. The discharge was divided into periods of 20 minutes, with periods of equal length between, the object being to determine, if possible, whether there is a local action in the mass of the plug due to the different chemical conditions of the different parts of the plug, which would especially be the case if the charge or discharge were rapid. As in the previous case of discharge, the rise of temperature was slow, there being a gain of but 1.3° for a discharge of 40 ampere-hours, the heating effect of the current in that time being 12 watts, equivalent to almost 4°. For the first three periods there was little, if any, rise during the time of repose; for the fourth period there was a rise of about .1°, or .3 watt-hours. During the fifth period the e. m. f. began to fall, and during repose after it the temperature rose .15°. The sixth discharge period was with the same current, but at a greatly reduced [illegible] and resistance. It lasted twelve minutes; after it the temperature rose .5°, corresponding to 1.5 watt-hours. The output of this discharge was 44 ampere-hours at a normal [illegible], 11 at a low [illegible]. The total rise of temperature was 3.5°, the value of C² R was 10 watts.

The cell was then charged with 70 ampere-hours at [illegible] amperes, the same periods of repose being [illegible]. There was a definite rise amounting on the average to about .2°; after the first period the rise was but .1°, the others slightly over .2°. The details of the charge were:

Ampere-hours.	Rise in temp.	Rate.	C² R.
15	1	[illegible]7	[illegible]
40	4.4	[illegible]	[illegible]
70	13.1	[illegible]	[illegible]

The details of the discharge at 30 were:

Ampere-hours.	Rise.	Rate.	C² R.
10	.14	[illegible]	[illegible]2
25	.62	[illegible]2	[illegible]
3[illegible]	1[illegible]2	.04	[illegible]
[illegible]	1[illegible]2	[illegible]	[illegible]
54 P. D. fell.	[illegible]	[illegible]	[illegible]

The rise during the periods of rest [illegible] at first small, but afterward something over .2[illegible]

The next charge was at a rate of 40 amperes. The following are the figures:

Ampere-hours.	Rise of tem.	Rate.	C^2 R.
[illegible]	[illegible]	.075	8.
42	[illegible]	.11	15.
[illegible]	8.0	.2[illegible]	22
[illegible]	[illegible]	.3	28.
[illegible]	[illegible]	.32	34.
	Rest		
10[illegible]	[illegible]	.30	36.75

The rise during periods of repose was .1° for the first period, .7° for the second, and decreased as the charge increased until it reached a value of about .2°.

The discharge corresponding to this charge was also at 40 amperes, and was divided into periods as before.

Ampere-hours	Temp.	Rate.	C^2 R.
14	[illegible]	.033	5.
2[illegible]	[illegible]	.05	11.
42	2.24	.077	17.

Whether the rise in temperature during the periods of rest is due to the heat of the plates being diffused into the liquid, or is due to a local action in the plugs, is difficult to determine. If it were due to local action we would expect a greater rise during the first periods of the charging experiments, and this is what we find. If it were due simply to diffusion of heat, we should have approximately the same effect at corresponding periods of charge and discharge, the rates being the same, but we see that it is greater during some of the charge than during corresponding discharge periods, and it is not uniform even during charge and discharge, it being sometimes greater when the resistance of the cell is less. Some of the rise is undoubtedly due to the diffusion of heat from the plates, but it seems certain that a part of the effect is due to the local action.

Our next experiments were with negative and positive plates which were in different conditions of charge and discharge. A test cell was made up of fully charged negative plates, with positives from which 45 ampere-hours

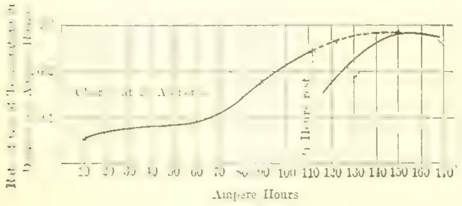

Fig. 4.

had been taken, and it was discharged in the calorimeter at 10 amperes.

Ampere hours.	Rise.	Rate	C^2 R
4.2	.05	.012	5
17.5	.2	.011	1.5
Rest			
35.[illegible]	[illegible]	.009	2.0
41.1	[illegible]	.03	4.0
[illegible] E. M. F. fell.	[illegible]	.13	6.0

Next a cell with fully charged positives and negatives from which 47.5 ampere hours had been taken, was discharged at a rate of [illegible] amperes.

Ampere hours	Rise.	Rate	C^2 R.
1	.1	—.01	.5
12.5	—.15	—.01	.75
2[illegible].5	—.20	—.01	1.00
2[illegible].	[illegible]	.00	1.1
29.	—.2	.00	1.4
[illegible]	—.2		1.65
[illegible]	—.17	[illegible]	1.9
[illegible]	[illegible]	—.0[illegible]	2.05
Rest			
[illegible]	—.2[illegible]	.04	2.45
[illegible] E. M. F. fell	[illegible]	—.11	2.55

Cell short-circuited, for very small current.

[illegible]	[illegible]
[illegible]	[illegible]
[illegible] hours	[illegible]
22 [illegible]	11.2
[illegible]	[illegible]

After [illegible] the cell was charged at [illegible] discharge being made at intervals [illegible] on closing the discharge [illegible] ampere hours had been [illegible] for eight minutes was [illegible] rising [illegible] the rates being [illegible]

[illegible] of 117 ampere hours [illegible] the rise was [illegible]

[illegible]

when the value had reached a few hundredths, the circuit was broken. In five hours the value was 1.65, and the next day it was 2.02 volts. With some plates made by depositing thin layers of [illegible] lead and peroxide on lead support plates the [illegible] was still more marked. Here the [illegible] of a negative [illegible] fell from a value of 1.8 to .05 in ten seconds; while with the positive the fall was gradual.

Now let us see what our experiments, as far as we have carried them out, show. In the first place the loss that exhibits itself in heating increases as the charge or discharge goes on, not being very great in the latter operation until the E. M. F. has begun to fall. The loss is greater during charge than during discharge. For instance take a discharge at 15 amperes [illegible] begins to fall when 60 ampere-hours have been taken out. The total rise in temperature is 2.03 degrees, while the rise due to the heating of the current alone (C^2 R) should be 3.4°. In other words, there has been an absolute lowering of the temperature by all the other actions outside of the joule effect. Taking a charge at 10 amperes, the rise for a charge of 100 ampere-hours, was 8.9° with a loss due to the joule effect corresponding to 3°, a difference of 5.9°. The difference in the losses for charge and discharge—neglecting C^2 R—is about 5.3°. For a charge of 120 ampere-hours, the rise was 11.15.

We will find the same results in all of the other records, there being sometimes an absolute fall of temperature on discharge. This is without doubt due to the fact that the acid is strengthened on charge, weakened on discharge. In changing from a specific gravity of 1.14 to 1.15 the evolution of heat is such as to raise the temperature of the solution about 3.2°; there will be a corresponding cooling effect on discharge.

To the above charge, at 10 amperes there was a discharge at 20 amperes, which gave a total of 84 ampere-hours, of which 60 were at normal E. M. F.; the rise for normal E. M. F. was 2.[illegible], the total rise was 4.7. C^2 R = 12.1 watt hours for the 60 ampere hours at normal E. M. F., corresponding to 3.8°; the total value of C^2 R for the 84 ampere-hours was 15.1, corresponding to 4.7. The total heat loss in process of charge and discharge was 11.5 + 4.7=16.2°, or about 51 watts. The total loss obtained from taking the difference between charge and discharge energies, calculated from the ampere-hours and potential difference, was 95 watts, more than half of which appeared as heat. Of the 51 watts which appeared as heat, 27 were due to the joule effect, 34 to other causes. We believe that part of this loss—a very small part—is due to local action between the positive material and the support plate. Another part is due to local currents in the plugs themselves. When the plate is charging or discharging, the distribution of current in the plug is not uniform, but it is denser at the surface than in the interior. After awhile the plug is not uniform in its chemical composition, and there are doubtless eddy currents in such a way as to tend to bring the plug to uniformity of chemical condition. These will be more important as the current rate increases. The last part of the charge of the cell consists largely in the electrolysis of the dilute acid with a liberation of oxygen and hydrogen. It is known that heat is generated in this process, the amount depending on the density of the acid and the nature of the electrodes. M. Gramme in some experiments on the electrolysis of water, only utilized 50 per cent. of the energy expended in producing electrolysis, the remainder being lost. In our own case, when the charge has reached such a point that the reduction of the plates is complete, and the principal action is the electrolysis of the solution into free hydrogen and oxygen; if the total E. M. F. is 2.5 volts, and if the energy of combination of oxygen and hydrogen corresponds to about 1.5 volts, we may expect of the energy of 2.5 watt hours, corresponding to a charge of 1 ampere-hour, 1 watt-hour to appear as heat. If we look at the tables, we will see that the rate of rise of temperature for overcharge is in the neighborhood of .3° per hour per ampere, and this corresponds to about 1 watt, as we would expect. As this action (shown by the evolution of gas from the plates) continues through the whole of charge and part of the discharge (doubtless due to local action in the latter case); we will always have *some* corresponding rise of temperature, although it will not reach its full value until the cell is boiling.

The rise of temperature then, is due to,

(1) The joule effect, 27 out of 51 in this case.

(2) Currents caused by local action between active material and support.

(3) Currents caused by local action in plugs.

(4) Heat losses corresponding to electrolysis of solution into free oxygen and hydrogen.

The last three probably account for the remaining 34 watts.

But there are 17 watts not accounted for, which must be due to chemical changes and reverse. The most important of these *[illegible] energy not accounted* is [illegible] the formation of [illegible] hydrogen and oxygen. Another component of the [illegible] watts is due to the local [illegible] and support. But we believe the most important, [illegible] is concerned, is [illegible] compounds caused by the [illegible]. We have found that [illegible] comparatively slow, so [illegible] there must be weak acid in [illegible] of active material is [illegible], causing [illegible], as described by [illegible] able [illegible] can be [illegible]. As the rate of diffusion [illegible] the charged plate [illegible] more marked effect with a [illegible]

[illegible]

losses are less with plane plates, coated with thin layers of active material, than with plates made of the grid form. Under any circumstances, an increase of surface for a given current rate is to be desired, as it lengthens the time of charge before the violent boiling occurs. A plane plate gives a uniform distribution of current, and therefore, very little local action.

THE PERSONAL ERROR IN PHOTOMETRY.

BY PROF. EDWARD L. NICHOLS.

Whenever, in the course of photometric work, different observers have occasion to compare the same pair of lamps, it will be found that the result of their readings with the Bunsen photometer differ by an amount very much larger than the apparent mean error of a single observation.

Ordinarily these differences are cloaked by the accidental errors due to the fluctuations of the lights under observation, and they have, consequently, not received the attention which they merit. There has been, indeed, so far as I know, no systematic attempt to determine the precise nature and importance of this personal error, the existence of which has doubtless been recognized by very many observers.

The introduction of the storage battery and the adoption of the incandescent lamp, supplied from the constant source thus afforded, as a secondary standard, has, however, entirely removed the large accidental errors resulting from uncontrollable fluctuations in our standard of illumination, and the personal errors just alluded to accordingly stand out in their true importance. I have very recently had occasion to make some experiments upon this subject, the results of which may be of some interest to those who have occasion to work with the Bunsen photometer.

The character of the errors with which one meets continually, whenever the reading of two or more observers are brought into direct comparison, may be very well shown by means of two sets of readings made by B. W. Snow and myself upon the same pair of lamps. These observations were made under precisely similar and uncommonly

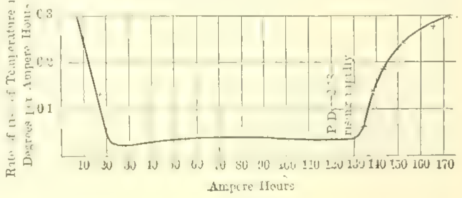

Fig. 5.

favorable conditions. The two lamps in question were of the same type, and being the only lamps in circuit with a large storage battery, they could be maintained at an almost absolutely constant voltage. These two sets of readings are not presented here as an example of what may be done with the Bunsen photometer in the comparison of constant sources of light. They are indeed of no great accuracy, and contain larger accidental errors than some observations to which I shall have occasion to call attention presently. They exhibit, however, very clearly the existence of the personal errors of observation which are to form the subject of this paper.

TABLE I.

Two parallel sets of ten readings upon the candle power of an incandescent lamp.

(1) (B. W. S. observing) Readings.	Differences.		(2) (E. L. N. observing). Readings.	Differences.	
C. P.	C. P.	P. c.	C. P.	C. P.	P. c.
12.12	.112 =	.91	12.56	.044 =	.35
12.32	.088 =	.72	12.60	.084 =	.67
12.16	.072 =	.59	12.36	.156 =	1.25
12.16	.072 =	.59	12.56	.044 =	.35
12.28	.048 =	.39	12.64	.124 =	.99
12.40	.168 =	1.38	12.60	.048 =	.67
12.28	.048 =	.39	12.56	.044 =	.35
12.08	.152 =	1.30	12.40	.116 =	.93
12.12	.112 =	.92	12.32	.196 =	1.35
12.40	.168 =	1.24	12.56	.044 =	.35
AVERAGES.					
12.232	.104	.852	12.516	.089	7.17

It will be seen from the above table that while the apparent mean error of a single observation is only about one-tenth of a candle, and the probable error of each set only .022 candle, the two averages themselves differ by .284 candle.

The following experiments were made for the purpose of determining the nature of this personal error:

Three incandescent lamps of the same type and voltage were selected, care being taken to choose specimens, the carbons of which were as straight as possible. These lamps gave 16 candles at 110 volts. They were connected in multiple to the terminals of a storage battery giving a potential difference of 120 volts. Adjustable resistances of German silver wire were placed in the line leading to each lamp and in one of the mains leading from the battery.

The lamps, together with the above mentioned resistances, were set up in a photometer room which contained two Bunsen photometers. The connecting wires were of such length that the lamps could be moved from one photometer bar to the other without breaking connections. One of the lamps was set up as a comparison standard at the end of the shorter bar. Each of the other lamps was then compared with this standard, the resistances being adjusted until these lamps were found to bear the same relation as to brightness to the standard. In other words, they were brought to the same intensity by a method which eliminated the systematic personal errors which it was my purpose to study.

The two lamps were then placed at the ends of the longer photometer bar, the length of which was 300 centimeters. It was divided into [illegible] equal parts. The lamps had been mounted with the plane of the filament at right angles

[illegible] with the photometer [illegible], and [illegible] taken [illegible] them up in [illegible] position to place [illegible] angle and presenting the [illegible] face to the [illegible] as before.

A closed circuit voltmeter between the terminals of the battery enabled the observer at the beginning of a set of readings to bring the lamps to the proper potential. In order to insure greater constancy in the degree of incandescence throughout the series of tests the lamps were maintained at a potential considerably below the normal, their candle power being about 12 instead of 16 candles.

A number of observers, all of whom were accustomed to photometric measurements, and some of whom had had extended experience, were asked to make a set of ten readings each upon the two lamps. The results of these two readings are given in Table 2.

TABLE 2.

Ratio of two incandescent lamps, previously adjusted to equal brightness. The measurements are made in the usual manner by means of the Bunsen photometer.

I_r and I_l are the intensities of the right hand and left hand lamps respectively.

Observer.	Ratio $= \frac{I_r}{I_l}$	Personal error.
A..........	1.0590 [illegible] .0040	[illegible]
B..........	0.9701 [illegible]	[illegible]
C..........	1.0021 .0022	.018[illegible]
D..........	1.0191 .0072	— [illegible]
E..........	1.0 82 + .0039	—.0150
F..........	1.0[illegible]02 [illegible]	— [illegible]
G..........	1.0733 .0053	.0701
H..........	1.0293 .0012	.0261
I..........	1.0207 [illegible]	.0263
J..........	1.0220 .0027	.0188

The true value of the ratio, $\frac{I_r}{I_l}$, determined previously by comparing each lamp separately with the standard, was 1.0032 [illegible] .0015, which value was used in computing the "personal" error.

It will be seen from inspection of the table that none of the averages fall at the middle of the bar, nor are they distributed around it in such a manner that the most probable value of the entire series, calculated by least squares under the assumption that only fortuitous errors exist, approximates to unity as it should do, were the lamps of equal brightness, and were there no systematic errors to vitiate the result. On the other hand the readings lie, with a single exception, on one side, namely, to the left hand of the center of the photometer bar. It will be seen, moreover, that the probable error calculated for each set separately, without taking cognizance of any systematic error, is very small in comparison with the differences between the mean results of the various sets, and especially in comparison with the variations of those averages from unity.

The Bunsen disk, with which these observations were made, was mounted in the usual manner, the two sides of the disk being viewed simultaneously by means of two plane mirrors set at the proper angle behind the former. It was noted that the almost universal habit in reading was to use the two eyes independently, one eye fixed upon each side of the disk. It seemed probable, therefore, that the personal error arose from the unequal sensitiveness of the observer's eyes, in that he would unconsciously set the disk at too great a distance from the lamp which illuminated the side of the disk which was being observed by his more sensitive eye. It appears, if we accept this explanation, that the right eye was the more sensitive in all the cases under observation excepting one, that of the writer (see Table 2, B), whose readings would indicate the opposite peculiarity.

In order to reverse the relation of the observer to the photometer bar, without altering any of the other conditions of measurement, a large mirror was set up opposite the photometer at a distance of about 40 centimeters. The observer, by sitting with his back to the bar, could then see the images of the Bunsen disk in the mirror, and his right and left eyes were reversed with reference to the lamps. Sets of ten readings were made in this manner by some of the same observers as before, the object being to test the hypothesis just stated. The results thus obtained were, however, complicated by the unforeseen circumstance that the method of using the eyes in observation was not the same when the image of the disk was seen in the mirror as when it was viewed directly. The observer, when using the mirror, no longer used his eyes independently, but scanned the image as a whole, so that both eyes had a share in determining the brightness of each side of the disk. The result was to produce a change in his settings, not by introducing a systematic error, equal and opposite to that occurring in the first series of observations, as had been expected, but by eliminating the error in question. In a word, the settings with the mirror were in better agreement than those made by direct observation, and they gave results much more nearly in accordance with the known equality of the lamps.

In my own case, however, an exception to the above statement must be noted, very possibly as the result of an effort to repeat with the mirror the precise method of observation followed in making the distance between the arc and the thermopile, or the relation of the [illegible] cell to either of them. By means of this apparatus measurements were made at angles of 0, 10, 20, 30, 40, 50, 60 and 63 below the horizontal planes. The following carbons were used:

[illegible]
[illegible]
[illegible]
(4) [illegible]
5. [illegible]
6. C[illegible] carbons [illegible]

The results of these measurements are given in Tables 2, 3, 4, [illegible]

In the following tables *D* is the deflection [illegible] tion, *d* the [illegible] giving radiation corrected.

TABLE II.

C[illegible] (unplated), diam. [illegible] inch.

Angle	*d*	*D*	$\frac{d}{D}$	*P. D* (Volts).
[illegible]	[illegible]	2[illegible]	.0182	[illegible]
10	[illegible]	2[illegible]	[illegible]	[illegible]
20	[illegible]	3[illegible]	[illegible]	[illegible]
30	27.3	[illegible]	.0780	[illegible]
40	[illegible]	3[illegible]	[illegible]	40
50	[illegible]	3[illegible]	[illegible]	[illegible]
60	[illegible]	300	.0677	[illegible]
63	[illegible]	125	.0432	[illegible]

TABLE III.

Carbon (unplated), diam. — .5[illegible]3 inch.

Angle	*d*	*D*	$\frac{d}{D}$	*P. D* (Volts).
0	6.8	165	.0412	41
10	10.[illegible]	195	.0554	42
20	2[illegible]	2[illegible]5	[illegible]	4[illegible]
30	32.8	264	.1242	[illegible]
40	3[illegible].2	274	.1441	42
50	28.4	252	.1137	41
60	10.8	12[illegible]	.0625	4[illegible]

TABLE IV.

Carbon (copper-plated), diam. [illegible] .5 inch.

Angle	*d*	*D*	$\frac{d}{D}$	*P. D* (Volts).
0	5.4	1[illegible]0	.0401	45
10	1[illegible].2	140	.0872	45
20	21.5	172	.1250	45
30	29.7	190	.1563	45
40°	33.8	195	.1733	45
50°	20.3	155	.1310	45
60	4.1	93	.0441	45

TABLE V.

Carbon (copper plated), diam. — .45 inch.

Angle	*d*	*D*	$\frac{d}{D}$	*P. D.* (Volts).
0	10.[illegible]	1[illegible]7	.0748	45
10	20.3	225	.0901	45
20	2[illegible].7	242	.1228	45
30	3[illegible].2	2[illegible]0	.1506	45
40	41.[illegible]	270	.1552	45
50	27.3	255	.1059	45
60	12.2	1[illegible]	.0676	45
63	5.4	110	.0492	45

TABLE VI.

Carbon (unplated), diam. — .37 inch.

Angle	*d*	*D*	$\frac{d}{D}$	*P. D* (Volts).
0	10.	180	.0555	40
10	14.[illegible]	190	.0789	42
20	24.4	200	.1220	38
30	31.[illegible]	217	.1474	37
40	3[illegible].2	230	.1[illegible]	40
50	42	240	.17[illegible]	42
60	33.[illegible]	205	.1[illegible]	42
63	1[illegible]	115	.0[illegible]	3[illegible]

TABLE VII.

Carbon (copper plated), diam. [illegible] .25 inch.

Angle	*d*	*D*	$\frac{d}{D}$	*P. D* (Volts).
0	13.5	1[illegible]0	.0[illegible]44	3[illegible]
10	22.0	185	.123[illegible]	3[illegible]
20	3[illegible].2	225	.1742	3[illegible]
30	[illegible]	255	.1800	3[illegible]
40	41.0	230	.1[illegible]22	3[illegible]
50	20.7	150	.1[illegible]	3[illegible]
60	[illegible]	[illegible]5	.054[illegible]	3[illegible]

[illegible] carbons.

[illegible]

.500

[illegible]

.250

[illegible]

C[illegible]

[illegible] carbon.	Diameter d.	[illegible]	[illegible]	[illegible]
[illegible]	m.m.	c. p.	[illegible]	[illegible]
40	7.12	417	[illegible]	[illegible]
[illegible]	11	[illegible]	[illegible]	[illegible]
1[illegible]4	1[illegible]	254	[illegible]	[illegible]
1[illegible]4	1[illegible]	1[illegible]	[illegible]	0.032
254	18.0	1[illegible]	2[illegible]	[illegible]

M. Schreih[illegible] states that this [illegible] satis[illegible] in the case of the mean [illegible] especially when the carbons are very small or very large. We have seen that this statement [illegible] iments upon the horizontal efficiency described in the first part of this paper.

CORRESPONDENCE.

New York Notes.

NEW YORK, June [illegible].—The silencing of the st[illegible] last Saturday by a refusal of the governors of the Stock Exchange to renew the contracts with the Gold and Stock Telegraph company and the Commercial Telegram company seems to have brought only confusion and a paralysis to one of the greatest financial markets of the world, and goes to show how no amount of tact and business intelligence can supply the place of the little electric current whose energy has perhaps been overlooked and under valued by the bulls and the bears until now. The exchange has been fighting for the last two years to get rid of the Commercial company because it furnishes quotations to the public which includes bucket shops and the Consolidated Stock and Petroleum Exchange. The courts hold that as long as the Stock Exchange sells its quotations, all competitors for distribution of the same must be served alike and at last both the competitors were silenced. This announcement to the exchange created wild enthusiasm, but the more thoughtful members were able to see the outcome of this step. During the last few days there has been nothing but a scrambling for prices, disgusted members and crazy clients. The pressure became so great that the officers of the exchange have been obliged to adopt a speedy return to the tickers. Out of a number of meetings between the governors, certain members of the exchange and the Western Union Telegraph and the Commercial Telegram companies, it seems that an agreement has been made so that the hum of the tickers will be heard again.

"The outcome of this most remarkable Wall street episode," says the New York *Sun*, "has proved that the authorities of the exchange had no well defined plan when they terminated their contracts with the quotation companies, and that better counsels than their own and good luck have brought them nearly back to the spot from which they started."

"It has been discovered at last that the Stock Exchange is dependent upon the ticker," says the *H[illegible]*, in other words, upon Mr. Gould. It practically belongs to him, notwithstanding the fact that there is a rival company in the field. With the Gold and Stock Telegraph company and the Western Union at his command he can [illegible] the ticker. The [illegible] adds: "It is [illegible] that Gould's company will absorb the Commercial company and thus secure the monopoly which has been [illegible] sought for in the courts."

The suit brought by the United States [illegible] company against the members of the Board of [illegible] Control has been discontinued on motion of [illegible]. The suit involved $25,000 damages [illegible] company because of the board compelling the company to place its wires underground. It is said that the company under its present Westinghouse management [illegible] act in harmony with the Board of Electrical Control, [illegible] should any differences come between the com[illegible]

[illegible] ners as officials and [illegible] jury for June has been sworn in and the charges preferred by Electrical Expert Wheeler against the United States, East River and Mount Morris Electric Light companies and their employes for putting up wires and lights without permits and [illegible] poles within the prescribed period, will be heard from the many supporting witnesses.

In the great phonograph suit now pending, Messrs. Gilliland and Tomlinson have sent in a formal notice of appearance through their lawyers, Coudert Brothers, and they will demur to the complaint. It will be remembered that Edison brought the suit in the United States Court and his claims involve an accounting for $250,000 worth of phonograph stock.

An accident to the electric light of the Statue of Liberty occurred Tuesday night. The light was visible only a few minutes and went out at [illegible] o'clock. The cause was a bursting of the steam pipe which connects the boiler with the engines for the immense dynamos which furnish the current for the great light. The pipe is being repaired so that "Liberty" will still continue to en-lighten the world.

The question of the hour seems to be electrical executions and it is interesting the legal, medical and humanitarian minds of the day. The notice of an appeal has been served upon District Attorney Quimby in the case of William Kemmler sentenced to be executed by electricity and Attorney Cockran, of this city, will apply for a writ of habeas corpus on which to test the power of the State in the case. The appeal will likely delay the execution for several months. In this connection it is also interesting to note the introduction before the Congress of Medical Jurisprudence which has been in session at Steinway hall during the week of papers pertaining to the electric current, from a "Medico-Legal" standpoint. An article was read on "Electricity and the Death Penalty" by Clark Bell. In a paper entitled "A Medico-Legal View of Electrical Distribution," Harold P. Brown pictured a rosy outlook for this town when electricity shall have been put to all the uses of which it is capable. Although it is generally conceded that an electrical execution should not be used as an advertising dodge, Mr. Brown could not resist the temptation to utilize the discussion of this topic for an onslaught on a system which he opposes in the commercial world. "Legislative Control of Dangerous Electrical Currents" was the title of a paper by Lawyer John Murray Mitchell, of this city, who said: "It is not in my province to day to discuss what currents may be fatal to human life, but rather to maintain that such currents as have been or may be proved to be dangerous even where the best insulation has been employed, should not be tolerated in any place where they can cause death or injury to the individual. I would divide electrical currents into two classes, viz. harmless and deadly. For all commercial purposes, currents of such low intensity can be used that no one, not even the most sickly babe, could be injured thereby. The question therefore resolves into this: Shall we allow a dangerous electrical current to be used when a safe one can do the same work?" Mr. Mitchell read a bill which he said he proposed to introduce into the Assembly, absolutely forbidding the use of currents of deadly electromotive force, except for executions, scientific experiments, and the like. W. H. T.

Detroit, Mich.

[illegible] —Detroit is getting to be quite an electrical city. The writer can remember the [illegible] the only electrical institu[illegible] manufacture and sale of electrical [illegible] Works. In the last [illegible] only have the Detroit [illegible] added many new de[illegible] other electrical companies have come into existence. Prominent among [illegible] Electrical company [illegible] president, and J. B. Trout [illegible] engaged extensively [illegible] batteries. They [illegible] has been [illegible]

[illegible]

the battery plates, with the salt in place These cubes are transferred by an endless chain to the gang-saws, which are large enough to saw the entire cubes into plates at one sawing. The salt is now soaked out of the plates, which then go up to the terminal room where the terminals are burned on. From the terminal room the plates go into the paste room, where 100 girls are employed in putting in the paste by hand The plates are now ready to go into the jars. This makes the battery complete and it goes to the forming room, where it is kept 120 hours before being shipped out.

The factory now has a capacity of 200 cells a day, and as soon as more furnaces and gang-saws can be put in place it will have a capacity of 500 cells a day.

The middle room on the first floor is the dynamo room, from which is obtained the current for forming the batteries. This room is being equipped with six dynamos, three of them being of 300 amperes' capacity each, one of 50 amperes, one of 75 amperes and one of 150 amperes The front room on the first floor is a store room.

On the second floor front are the executive offices of the company and a very large show room. The middle room is given up to shipping purposes and the rear apartment is the red lead room. The third floor front is used for store room purposes, and here, too, is a laboratory 25 by 75 feet. The middle room of the third floor is the assembling room, and the rear room is the forming room. The acid tanks are also in this room.

It may be interesting to know that steam is kept up to generate current for the forming room only during the daytime. At night the batteries being formed are simply connected with batteries already charged, and the forming process is thus continued without the use of the dynamos.

The above is a brief description of one of the largest storage battery factories in the United States. The company is overrun with orders, but will soon be in shape to keep up with the demand, as the factory is capable of an ultimate capacity of 1,000 cells a day. To give an idea of the demand for storage batteries, a few places where batteries of this company's make have been shipped within the last few days are noted. As the storage battery business in a commercial sense is comparatively new, it is interesting to note the fact that orders come from the smallest towns as well as the largest cities, and in some cases requisition is made for only a single cell, while in other cases, as in the case of a large street railroad equipment, the orders run into thousands. Following are orders shipped within the last two or three days:

Carthage, Mo., 100 cells; Estey Organ company, Brattleboro, Vt., 4 cells; San Francisco, Cal, 29 cells; Milwaukee, Wis, 60 cells, Ludington, Mich., 60 cells; Western Electric company, New York, 58 cells; Pennsylvania Railroad, New York, 16 cells; Ottawa, Can., 23 cells; Hart Emory Wheel Works, Detroit, Mich., 32 cells; Leonard & Izard, Chicago, 13 cells; Voigt's Brewery, Detroit, 62 cells; Michigan Central Railroad, for President Ledyard's private car, 22 cells; Farrand & Votey Organ company, Detroit, 50 cells; Michigan Phonograph company, 9 cells; School of Mines, New York, 6 cells.

It is expected that the different local phonograph companies will become large buyers of batteries. The demand for the batteries from organ factories is also increasing. The bulk of the orders for storage batteries, however, come from the railroad companies for train lighting and signaling purposes, and from owners of private electric light installations It is evident that we are to have as rapid development in the storage battery field as we have seen in the electric light and power fields. The Woodward company is getting its business in the manufacturing department into the best possible shape so as to take advantage of the growing demands in this field.

The Parrish Bros. & Peck Electrical company is located at 35 Third street, Detroit. This company devotes its energies mainly to the supply of signaling apparatus for railroad companies, and it has built up a large business in this direction. General Manager Chadwick informs your correspondent that their business is growing rapidly, and that the railroad companies are beginning to realize that the only successful way to handle their trains, especially freight trains, is by the use of a satisfactory signal system. Such a system the Parrish company has, and it has demonstrated this fact to several of the large railroads, the result being large orders for the apparatus.

The Markle Engineering company is located at 133 Jefferson avenue. Its principal work is steam, gas and [illegible] engineering. The company also manufactures [illegible] patent [illegible], and it is the proprietor of [illegible] cylinder oils. It handles a [illegible] of [illegible] and power supplies, and [illegible] F. Markle, so well known [illegible] the Edison Electric Light company, is president and treasurer of the Markle Engineering company. S. L. Beales is the secretary and N. F. Stoddard the superintendent.

The Commercial Electric company is the latest venture in Detroit. This company is composed of two young men well known in the electrical business, Messrs. Fitzgerald & Fisher. They are planning to do a general electrical supply business as well as contract and engineering work. They have secured the agency for several important electrical manufactures, prominent among which is the Slattery induction apparatus. Messrs. Fisher and Fitzgerald are young men of energy and business experience, bent upon succeeding

The Detroit Electrical Works, mention of which has been made before in this article, find their business increasing beyond all expectations This increase is not confined to any one department, but is general throughout the different lines. Manager Fisher finds his hands full in looking after the company's large business, and President Jackson can generally be found at the factory also. The company has finally turned over its motor business to the National Electric Traction company, which has now the entire control of the Fisher Rae motor apparatus as far as selling and installing are concerned. The Detroit Electrical Works, however, continue to manufacture the apparatus for the National Electric Traction company

The Detroit Motor company is another concern in Detroit engaged in the manufacture and sale of motors. It confines itself, however, mainly to the small sizes of machines It is said to enjoy a nice trade in this line. K

San Francisco, Cal.

SAN FRANCISCO, June 6 —The California Electric Light company has taken possession of its new station, and has five arc machines running.

The Oakland city council has authorized the appointment of a committee to investigate the subject of the construction by the city of the necessary lines and poles to light the city throughout by electricity.

The San Jose Gas Light company and the Brush Electric Light company, of that place, have consolidated. The gas company has been agitating the subject of running electric lights, but eventually concluded to take the local company's plant.

The California Electrical Works of this city are manufacturing automatic shocking machines of the "drop a-nickel-in-the-slot" class. The apparatus consists of a coil and dry battery. The machines have become popular.

J. W. Hayes, assistant superintendent and manager of the Western Union Telegraph company at Portland, Ore., has tendered his resignation, to take effect June 1st, when he will accept the position of district superintendent of the Postal Pacific company for Oregon and Washington.

W. G. C.

Ithaca, N. Y.

ITHACA, N. Y., June 8.—The Electrical Engineering association of Cornell University held a meeting May 24th at which George D Shepardson read a paper on "The Generation of Electricity from Heat." It was very interesting and instructive. He took up both methods, the thermopile and the pyromagnetic generator, giving the efficiency of both. On June 5th L. B. Marks presented a paper on "Arc Light Carbons" in which he stated that after a series of experiments it was found that the moulded carbon gave a greater efficiency when used with high tension current and the forced carbon with low tension current. The life of the carbon was found to vary directly as its diameter and inversely as its resistance.

Dr. R. H Thurston, director of Sibley College, Cornell University, sailed for France, Wednesday, May 29th, where he will remain uutil September. He was one of the number chosen as jurors to award the prizes at the Paris Exposition. He is also a representative of the United States organization of the International Congress of Scientists and Engineers. P.

Omaha, Neb.

OMAHA, June 2. —In the amended articles of incorporation of the Omaha Motor Railway company the stock is put at $120,000, one-half of which is paid in, and the other half payable on demand.

The erection of poles for the Consolidated Street Railway company's motor lines has extended to the across-town line from Cumming street to Hanscom park. The company's contract with the Sprague Motor company calls for twenty motor cars, and a number of "trailers" or coaches yet to be ordered Probably two 250-horse power engines will be bought, and the power house will be at some point on the Belt Line spur north of Izard street. Three months will elapse before the system is put in operation L.

THE ELECTRIC LIGHT.

Campbellford, Ont., is installing an electric light plant.

Port Hope, Ont., will introduce public lighting this year.

The Ball Electric Light plant at Virginia, Ill., has been increased by fifty lights.

Victoria, B. C., has guaranteed 5 per cent on $40,000 to build an electric railway.

The Whitney Iron Works company of New Orleans has installed an electric light plant in its establishment.

The Rankin Electric Light company of Tarkio, Mo., is installing a Thomson Houston incandescent system in that city.

The electric lighting system of London, Ont., will be extended so as to include the streets on the outskirts of the town.

The Bryan Electric company of Bryan, O., has adopted the Schuyler system, and until it can complete its station has made a temporary installation.

A 50 horse power engine has lately been installed in the Ball plant in the Bowman building, Chicago, and 50 additional arc lights are to be added within 30 days.

The Westinghouse Electric company has put out its new meters among central station companies to the extent very nearly of 100,000 16 candle power lamp capacity. The meter, it is reported, is giving satisfaction.

The electric light plant which illuminates the city of Titusville, Pa., has just been started. The plant consists of a 60 arc light dynamo and lamps manufactured by the Van Depoele Electric Manufacturing company, of Chicago, Ill.

The Sycamore Electric Light company, of Sycamore, Ill., has just contracted with the VanDepoele Electric Manufacturing company, of Chicago, Ill., for a 60 arc light plant and 500 incandescent lights for furnishing illumination for the citizens of that town.

The Van Depoele Electric Manufacturing company, of Chicago, Ill., is placing electric light plants upon the following excursion steamers of Chicago: Steamer Chief Justice Waite, 10 arc lights; John A. Dix, 150 incandescent lights; steamer Gordon, 100 incandescent lights.

The contract for lighting Manitowoc, Wis., has been awarded, after sharp competition, to Leonard & Izard, of Chicago. The territory to be covered is of an area of 3x1½ miles. Residences, as well as the streets and stores, will be lighted. The system to be installed is the "Edison 3 wire," and the plant will be started with a capacity of 2,000 lights.

The Thomson-Houston company of Chicago reports the following recent installations: Mitchell, Dak., 600 alternating and 30 arc lamps; Wabash, Mo., 50 arc; Escanaba, Mich., 600 incandescent; Neenah, Wis., 600 incandescent; Schlitz Brewing company, Milwaukee, 500 incandescent; Santa Cruz, Cal., 300 incandescent. In addition to these new installations the following additions have been made to the old plants: Cadillac, Mich., 30 arc; Denver, Col., 70 arc, and 1,800 incandescent; Helena, Mont., 1,000 alternating.

Among the orders for alternating current central station apparatus recently received by the Westinghouse Electric company are the following outfits: Sioux City, Ia., increase, 750 lights; Clinton, Ill., increase, 750 lights; Yankton, South Dakota, 750 lights; Guthrie, Ind. Ter., 750 lights, and 35 Waterhouse arc lights; Birmingham, Ala., 1,000 lights; Jersey City, N. J., 750 lights; Seattle, Wash. Ter., 750 lights; Montesano, Wash. Ter., 500 lights. These orders bring the number of Westinghouse central stations up to 178.

Oakland, Cal., by reason of a provision in its charter, is now a prey to the gas companies which illuminate the streets. This provision prohibits the making of a contract for public lighting for more than one year. Accordingly the electric light companies would not feel justified in establishing an extensive and costly plant only to have it thrown back on its hands at the end of the year. It is therefore suggested by a member of the city council that the city purchase and operate its own plant and light the city by electricity after the manner of Chicago.

The New York *Sun* quotes an old sailor on the removal of the tower at Hell Gate, and the complaints against the electric lights in the tower: "The men who complained of the light were the pilots and tugboat men. The reason was that before the light was put there all sailing vessels going through Hell Gate at night had to get a boat to tow them through. After the light was put in Hell Gate was so light that sailing vessels could go through without the aid of a tugboat. Of course this was money out of the pockets of the tugboat men and pilots."

The Belton, Tex., station, using the Heisler system, has just been started. Heisler plants at Fort Arthur and London, Ont., and Montrose, Colo., were started last week. The installation of the Heisler plant of 1,000 30-candle power lights at the Paris exposition is now being completed. Mr. Heisler expects to leave for Paris in a few days to give this exhibit his personal attention. Among contracts recently received is one for lighting the art department of the St. Louis exposition, the lighting of this department by the Heisler company last fall having proved satisfactory.

The Van Depoele Electric Manufacturing company, of Chicago, Ill., has just contracted with the People's Electric Light company, of Streator, Ill., for a 200-light Mayo long distance incandescent series electric light plant to light the outskirts of that city, displacing the gasoline lamps. This makes the plant at Streator consist of 60 arc lights, 1,000 direct system Mayo incandescent lights and 200 long distance incandescent lights. The company is now operating in its new station near the [illegible] depot and claims to have one of the most complete and best equipped electric light stations in America.

The St. Paul *[illegible]* says in the course of an article on the underground system in that city: "[illegible] has been [illegible] as to the source from which [illegible] business of the Dorsett conduit, now under construction, will be drawn. The Edison company holds a franchise from the city giving it the right to put down its own conduit and to use whatever style of conduit may be put in the streets. The Northwestern Telephone company is endeavoring to secure a franchise for a conduit of its own adoption, and as the council has not yet made it mandatory for these companies to put down any conduit or to go under ground in the Dorsett conduit when it is constructed, it would seem that the latter would have little business to depend upon." All of the electric companies oppose the Dorsett system. "The Northwestern Telephone company would like to use its iron pipe, but the council thus far has not seen fit to coincide with its views, and there are symptoms that so soon as the Dorsett conduit is laid a sufficient distance to demonstrate its merits, the council will, upon being satisfied that it is what Mr. Dorsett claims, give all the overhead wire corporations notice that they must go underground, giving them a proper length of time in which to prepare for the change. To go underground would necessitate a new plant of wires for the Edison company and the gas company and Western Electric Lighting company."

THE ELECTRIC MOTOR.

A company has been formed at Berkeley, Va., to build an electric railway.

The Kanawha Electric Light company will build an electric railway at Charlestown, W. Va.

Electricity had made made but little headway at the time of the flood. What Noah most needed and could not get was an arc motor.—*New Orleans Picayune.*

The cars for the electric street railway at Stillwater are now in the power house, and the motors and wires are being put in place. The road will be in operation soon.

Horses will be used but a comparatively short period longer by the Gloucester, Mass., Street Railroad company, as arrangements have been made for the introduction of an overhead electric system.

The Newstead Avenue Elevated Electric Railway company of St. Louis filed its bond with the city register on the last day of grace, thus securing its franchise, but it is probable that there will be no work done for several months.

There is some talk of an electric railway across the Eads bridge, St. Louis, to replace the omnibus line that is running at present. If a franchise can be obtained from the city of East St. Louis, Ill., so that the cars can be run from the east appoach to the center of town, it is quite probable that it will be built.

The Sprague Electric Street railway at Atlantic City is giving satisfaction, and with the large influx of summer visitors, the passenger traffic is increasing enormously. Each of the motor cars draws one additional car, though a great many of the motor cars are only equipped with a single 15-horse power motor.

The Thomson-Houston company of Chicago has been awarded the contract for the Ottawa, Ill., Electric Railway company's new plant. Five miles of track will be laid, and twelve new cars put on the line. The latter will be constructed by the Pullman company and fitted up with the latest improvements in the Thomson-Houston company's system.

An electric railroad has just been completed in Scotland between Carstairs House and the Caledonian railway in connection with the lines at the former place. The source of power is a waterfall three miles distant. It is said in the report of the trial trip that a speed of thirty-five miles was easily attained and might have been surpassed. Probably this is a slight exaggeration. The motion was smooth, and everything about the new road was satisfactory.

THE TELEPHONE.

The Connecticut house has passed a bill imposing a tax of fifty cents a mile on telegraph companies having more than two lines of wire and 25 cents a mile on all other telegraph companies; also imposing a tax of 70 cents on each telephone transmitter, and a further tax of 20 cents on each mile of wire.

A Pittsburg telephone inspector recently told the following to a reporter: "A telephone is like a human being in some respects. There are some of them that are always out of order and costing the company money, and some of them do not need attention once a year. Now and then a telephone needs repairing so much that the company actually loses money on it. I've known a telephone to get out of order mysteriously and defy all attempts to locate the trouble for a few days, and then in an equally puzzling way it would come out all right. We don't know half as much about electricity as we will after awhile, and there are many things about the telephone that we don't understand, but one or two simple lessons about it should be learned by every one. For instance, every user of a telephone should know that when he is listening and the voice at the other end of the line becomes now fainter and now more distinct, that induction from other wires is causing the interruption, and that the trouble will be only temporary. Hang up the audiphone, take it down in a minute, and everything will work all right. But when there is a rattling in the telephone, disturbing the sound, and sometimes cutting it off altogether, there is something wrong that needs the attention of an inspector."

THE TELEGRAPH.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] in Chicago [illegible] defunct Great Western Telegraph [illegible] scattered [illegible] effect it [illegible] liable for indebtedness of the company [illegible] Receiver Bonen from collecting an assessment [illegible] cent. on stock subscriptions of nearly $3,000,000. Among the stockholders winning the victory are [illegible] and other prominent business men of Chicago.

Miscellaneous Notes.

The Shaefer Electric Supply company of Toledo, O., was incorporated last week with a capital stock of $[illegible].

The *Electrical Mechanical [illegible]* [illegible] Ont., is the new form of a prominent trade paper of the Dominion. In the future the electrical department will be a special feature.

The Chicago Electric Holder company has been incorporated to manufacture and sell electric holders; capital stock, $5,000; incorporators, A. H. Bacon, F. C. Hoyt and E. W. Banister.

Prof. M. O'Day, of the electrical department of the University of Notre Dame, contributed an interesting article to the last number of the *Notre Dame Scholastic*, descriptive of the Edison laboratory at Orange, N. J.

The directors of the St. Louis exposition announce their belief that the exhibition in September will be the most important in the history of the city. The electrical display will surpass everything in its line that has heretofore been anticipated, if the directors' expectations are fulfilled.

Business Mention.

The Illinois Belding Motor company has secured new quarters at 144 Adams St., Rookery Building, Chicago.

Partrick & Carter announce that their catalogue is in the printer's hands, and will be issued soon. The delay was unavoidable.

The Peckham Street Car Wheel & Axle company is equipping new shops at Kingston, N. Y., with the latest machinery and tools for manufacturing wheels for the motor trade.

The Empire City Electric company of New York city has a large assortment and complete outfit in electric light lamps, shades, switches and every form of device used in electric lighting.

The New England business of the Sprague Electric Railway & Motor company of New York, will hereafter be conducted by the New England Electric company, with offices at 55 Oliver street, Boston.

The Nebraska Electric company of Omaha reports an excellent business and a promising outlook. Among its recent sales is a storage battery plant and construction material for 400 lights at Tarkio, Mo.

The Cleverly Electrical works of Philadelphia are making a specialty of small sizes of Perret motors and [illegible] carbon batteries. The merits of these specialties are too well known to require special mention.

Eugene Munsell & Co. of New York city make a specialty of mica for electrical purposes. This mica is particularly desirable for commutator insulation, and is highly commended by those who have had practical experience with it.

The Heisler company's catalogue, illustrating and describing the advantages of its system of electric lighting, has just been issued. It contains numerous [illegible] experts and extracts from scientific journals [illegible] the system highly.

The Pond Engineering company, through its [illegible] representative, has lately sold to [illegible] Cook, Neb., an [illegible] horse power steam plant, [illegible] boiler, Armington & Sims' engine, boiler feed [illegible] heater to run an electric light station.

The Consolidated Temperature Controlling company of Minneapolis, Minn., has assumed control of [illegible] of the Union Automatic Heat Regulating company of Elmira, N. Y., and now has the [illegible] and Sternberg patents in its possession.

The Globe Carbon company of Cleveland, O., has increased its capacity to [illegible] by next fall to make an additional increase. The company is rushed with orders and the [illegible] next winter is very flattering. The company is now mak-

ing an excellent carbon for the low tension currents. It [illegible] Brush and Thomson-Houston systems 1,200 candle power, 6, 8, 10 ampere cur- [illegible] to 10 ampere cur- [illegible] satisfaction. The [illegible] its Ball carbons for 4 ampere current 800 candle power.

The Electrical Supply company of Chicago has issued a [illegible] lamp hanger with ad- [illegible] has been de- [illegible] the WESTERN ELECTRICIAN. An [illegible] the apparatus is that it is not sup- [illegible] the [illegible] wires.

[illegible] western agent of the Daft company, has [illegible] bank building, 119 and 121 La Salle street, Chicago. Recent sales of the [illegible] Chicago Photo-Engraving [illegible] horse power motor, [illegible] Fernendt, 1½-horse [illegible] Manufacturing company, 1½-horse power [illegible] horse power motor.

[illegible] of Philadelphia have issued a circular letter informing their patrons that they have instructed their representatives in Paris to personally attend the direction of the former, who may desire to purchase apparatus of any description. It is often inconvenient for Americans, especially those who are not thoroughly conversant with the French language, to attend to the details of shipping, etc. On this point the company says: "We shall be pleased to relieve purchasers entirely of all this care, so that they need have nothing to do but select the apparatus. Our agents will then attend to the packing, shipping, passing through custom house, etc., in the same manner as if the order had been placed with us here in Philadelphia."

Electrical Patents.

Issued June 4, 1889.

404,3[illegible]. Submarine Search Light. Andrew L. Dutton, Racine, Wis.

404,42[illegible]. Unison Device. George F. Oehmen, New York, N. Y.

The invention consists primarily in having at the receiving stations a slot or notch at zero; that is to say, the unison point on the escapement wheel, adapted to receive an elongated pin secured to the escapement lever.

404,43[illegible]. Non-Interfering Fire Alarm Signal Box. John J. Ruddick, Richmond, Ind.

404,441. Motive Mechanism for Railway Cars. Henry [illegible] Shaw, Boston, and George F. Shaw, Dedham, Mass.

The object of this invention is to convert in a simple manner, and with little friction, the high speed of the motor shaft into comparatively low speed for the car axle.

404,457. Railway Signal. A. Jackson Wisner, Philadelphia, Pa.

404,463. Filament for Incandescent Electric Lamps. Turner D. Bottom, New York, N. Y.

The filament is composed in whole or in part of a molybdenum compound of a refractory character, the compound preferred being the disulphide, which, as found in its natural state, is called molybdenite.

The first and last claims are given:

"1. The process of manufacturing filaments, consisting of forming a deposit of molybdenum compound in or upon a suitable filamentary body.

"6. The process of manufacturing filaments, consisting in incorporating a suitable filamentary body with oxide of molybdenum and then electrically heating the same in the vapor of a compound of sulphur [illegible]"

404,465. Electric Motor. Charles S. Bradley, Yonkers, N. Y.

The inventor states that he has discovered that the Foucault currents "may serve a useful purpose in the motor or machine, and may be so concentrated and directed as to form the sole energizing currents of the field magnets, and such discovery forms the basis of [illegible] which, briefly, consists in an electric motor (or dynamo-electric machine) having its [illegible] currents induced in the [illegible] distinguished from the [illegible] magnet by a current [illegible] conductors wound [illegible]

[illegible] Electric Motor. Charles [illegible]

[illegible] motor having [illegible] the [illegible] of [illegible] field circuit [illegible] speed.

[illegible] rent electric motor having [illegible] led with [illegible] of a [illegible]

[illegible]

404,471. Telephone Transmitter. Edwin S. Drake, Cambridge, Mass.

The invention deals exclusively with that part of the construction of a transmitter which relates to conducting the sound impulses to and from the outward face of the diaphragm.

404,484. Dynamo-Electric Machine. William Hochhausen, Brooklyn, N. Y.

The principal feature of the invention consists in providing the armature core with shallow grooves, in which the armature conductors are partially embedded.

404,507. Telegraph Apparatus. Ebenezer B. Shafer, New York, N. Y.

404,518. Fire Alarm Telegraph. Sidney A. Chase, Evart, Mich.

404,519. Duplex Fire Telegraph. Sidney A. Chase, Evart, Mich.

Claim 2 reads as follows:

"A signal transmitter for use in a duplex system of fire or analogous signals, consisting of three disks, two of which have a definite signal on the same side of their periphery, the third having constant metallic contact with an earth circuit, while the others are connected by individual contact springs and normally-open main line circuits running by diverse routes to a receiving station, said main lines including receiving instruments."

404,533. Electric Motor and Regulator. Alfred Gartner, Newark, N. J.

The last claim is:

"2. In a motor, the combination, with a series of magnets having broad end plates with wires wound between, of another series of like construction, movable between the first, the plates of one series being presented to those of the other."

404,559. Track-Moistening Apparatus for Electric Railways. Edward D. Priest, Lynn, Mass.

The invention consists in moistening the track sufficiently to insure good electrical connection between it and the wheels of the vehicle.

404,566. Method of Distribution by Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

The first claim follows:

"The method of electrical distribution which consists in the generation of an alternating current by the superposition of two alternating currents differing in phase and the derivation of currents therefrom, some dependent upon the component currents and some upon the resultant currents formed by their combined action."

404,567. System of Generators for Alternating Electric Currents. Oliver B. Shallenberger, Rochester, Pa.

The fourth claim reads:

"The combination, with two alternating current electric generators delivering two currents differing in the time of their phases, of translating devices deriving currents from the respective generators and other translating devices deriving currents due to the superposition of the two currents of the said generators."

404,600. Determining the Temper of Iron or Steel. Carl A. Caspersson, Forsbacka, Marzretchill, Sweden.

The claim is as follows:

"A method of determining the temper of iron or steel, consisting in conducting an electric current through a sample or test-piece of the iron or steel, the temper of which is to be determined, melting it off, and comparing the intensity of the current requisite with the strength of the current required to melt off pieces of normal steel of the same minimum cross-section as the sample, and of known temper, either directly by placing the above-mentioned normal pieces in the same electric circuit, or indirectly by the aid of an amperemeter."

404,602. Regulator for Dynamo-Electric Machines. Ernest P. Clark, New York, N. Y.

The invention relates to the automatic regulation of dynamo electric machines. It is designed for the regulation of the constant current shunt wound machine, and it consists of a small electro motor having its field magnets in the main circuit of the dynamo, and its armature in the shunt circuit, which also includes the field coils of the dynamo. The counter electromotive force of this motor is the regulating power.

404,630. Induction Coil. John F. Kelly, Hoboken, N. J.

The first and last claims are appended:

"1. The combination, with a sectional longitudinally grooved core and primary and secondary coils wound thereon, of a sectional casing or armature surrounding and inclosing the core and coils.

"4. An induction coil or transformer of alternating electric currents, consisting of a sectional iron core provided with grooves or channels, primary and secondary conductors and an outer sheathing, the primary and secondary conductors being wound in the same grooves or channels, and being equally close to both the core and the sheathing."

404,6[illegible]. Safety Attachment for Electric Motors. William S. Paca, Baltimore, Md.

The invention consists in means whereby the breaking of the driving belt or its slipping off closes a short circuit around the motor and stops the machine.

404,6[illegible]. Electric Motor. Henry B. Slater, Detroit, Mich.

The motor is especially designed for dentists' use [illegible] The invention relates to [illegible]

404,6[illegible]. [illegible] Electric Wire Cutter. Daniel A. [illegible] and Thomas A. Porter, [illegible]

[illegible]

[illegible] consisting of wooden cores provided [illegible] in combination with rubber tubes having enlarged portions and passed over the said cores, the enlarged portions being at the ends of the said tubes and located upon the said cores at those ends opposite the ends of the cores containing the said holes."

404,680. Telephone Support. Charles W. Brown, Montreal, Quebec, Canada.

The claim is as follows:

"A telephone transmitter carried in a cup formed on a casting to which the mouth piece is attached, said casting having an extension terminating in a sleeve sliding on a vertical rod secured to box containing induction coil, or to any other suitable base, and means for securing sleeve at desired height."

404,682. Apparatus for Purifying and Aging Liquors. Samuel G. Cabell, Washington, D. C.

404,687. Electric Railroad. Leo Daft, Plainfield, N. J.

The first claim reads:

"In an electric railway, the combination, with the insulated plate, of the vise-grips secured thereto and supporting the trolley conductors, posts arranged along each side of the track supporting the main current conductors, wire-connectors between the posts and plate serving to support the plate and conduct the main current to the trolley conductors, and electric connections between the connectors and the main current conductors."

404,698. Portable Electric Lantern. William Frishmuth, Philadelphia, Pa.

404,699. Galvanic Battery. William Frishmuth, Philadelphia, Pa.

The last claim is given:

"4. In combination with the electrodes of a galvanic cell, a mass of pumice stone in comminuted form interposed between said electrodes, containing in its pores a depolarizing substance, and saturated with an electrolytic solvent of said substance."

404,712. Detachable Brush Holder for Dynamos. Jesse F. Kester, Terre Haute, Ind.

Claim 4 reads as follows:

"An armature shaft bearing, in combination with a collar loosely embracing the same, a brush holder support partially embracing the collar, and removably secured to the same, and a handle to adjustably clamp the parts in position."

404,713. Armature Core for Dynamos. Jesse F. Kester, Terre Haute, Ind.

The first claim is appended:

"As an article of manufacture, a removable interchangeable armature for dynamo-electric machines or motors, comprising a cylinder open at the ends, a series of rings embracing and clamped together upon the periphery of the cylinder, and end pieces provided with aligned central openings to removably receive the armature shaft, and with radial arms engaging the ends of the cylinder."

404,714. Regulator for Dynamo Electric Machines or Motors. Jesse F. Kester, Terre Haute, Ind.

The seventh and last claims are given:

"7. A dynamo or motor regulator comprising a normally-open short circuit, including one or more armature coils, and a circuit-controller and speed-governor to close the circuit when a predetermined speed is reached.

"13. A dynamo or motor regulator comprising a normally-open regulating circuit, a circuit controller included within the same, and a resistance coil located within the armature, and also included within the circuit, to reduce sparking and equalize the abrupt effect when the circuit is closed."

404,715. Brush Spring for Dynamos. Jesse F. Kester, Terre Haute, Ind.

Claim 3 is:

"In a dynamo or motor, the combination of a brush holder support provided with spindles extending parallel with the periphery of the commutator, brush holders loosely mounted upon said spindles and provided with transverse sockets, brushes secured in said sockets, to bear upon the commutator and swing to or away from the same in planes transverse to its axis, and a retractive spring connecting the holders to yieldingly hold the brushes engaging the commutator."

404,745. Method of Filling Teeth. Elbert C. Taylor, Humansville, Mo.

404,783. Regulator for Electric Motors. Alfred Gartner, Newark, N. J.

404,801. Electric Meter for Alternate Currents. Marmaduke M. M. Slattery, Fort Wayne, Ind.

Claims 3, 5 and 7 are:

"3. The combination, for use in an alternating current meter, of a copper cylinder and soft-iron disks placed normal to its axis rotating in the inductive field.

"5. In an alternating current meter, a secondary coil or closed conductor consisting of copper circuits of low resistance, all in electrical multiple connection with each other.

"7. In an alternating current meter, a secondary coil made from a continuous shell of conducting material sawed into ribs and enveloping that member of the mechanism to which motion is communicated by induction."

404,813. Electric Cable Terminal. Robert H. Widdicombe, Chicago, Ill.

The object of the invention is to provide a terminal connection for such cables of such construction that moisture may be kept away from the paraffine or other filling at the end of the cable, while the conductor is covered so as to avoid the liability of accident in handling, and at the same time ready means afforded for connecting a kerite, gutta-percha or other insulated conductor therewith.

ELECTRIC LIGHT PLANT—BIDS WANTED.

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(Signed) J. A. CROZER, A. T. BLISS, } COMMITTEE

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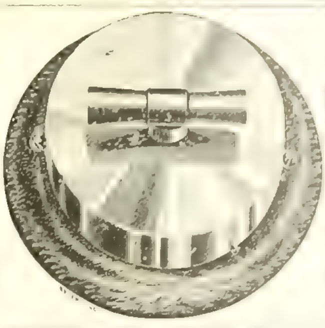

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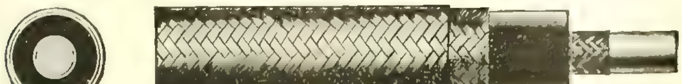

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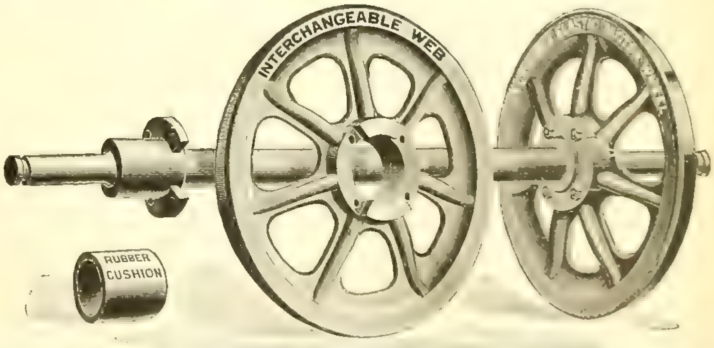

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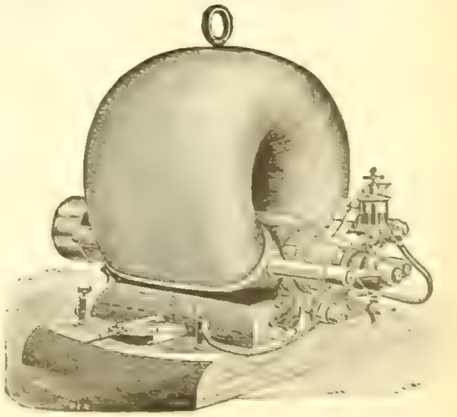

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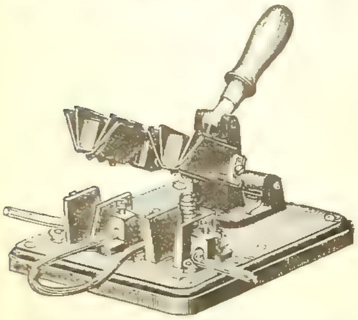

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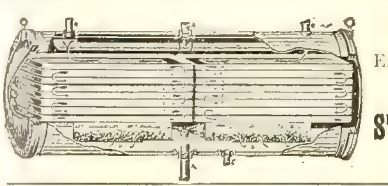

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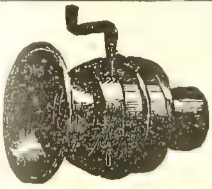

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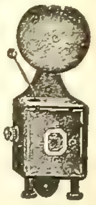

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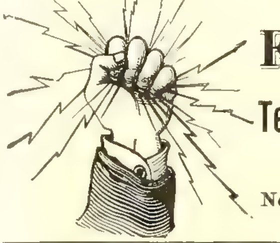

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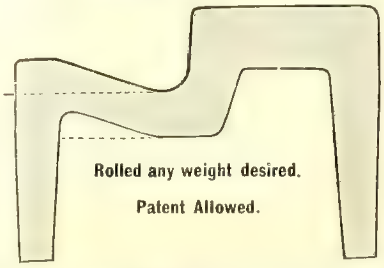

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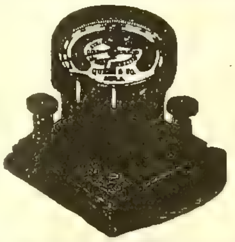

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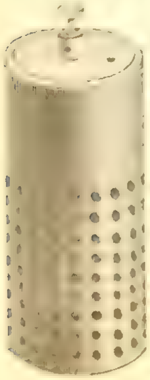

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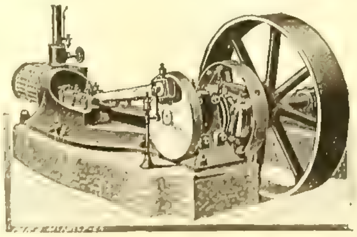

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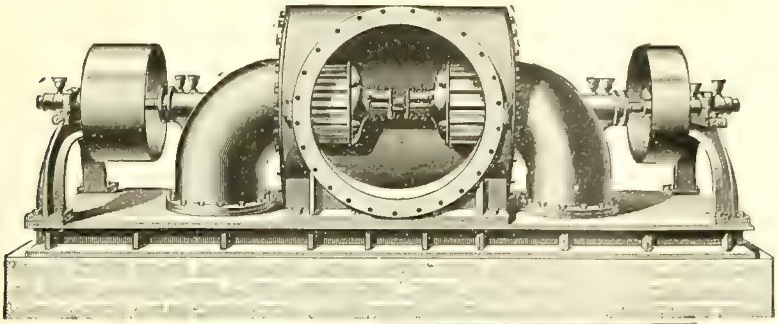

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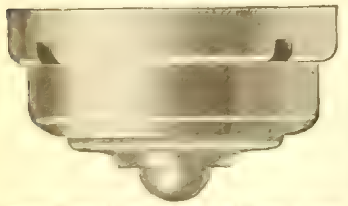

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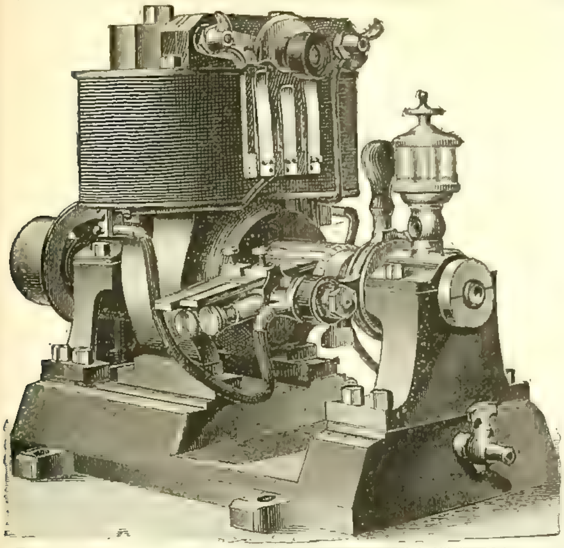

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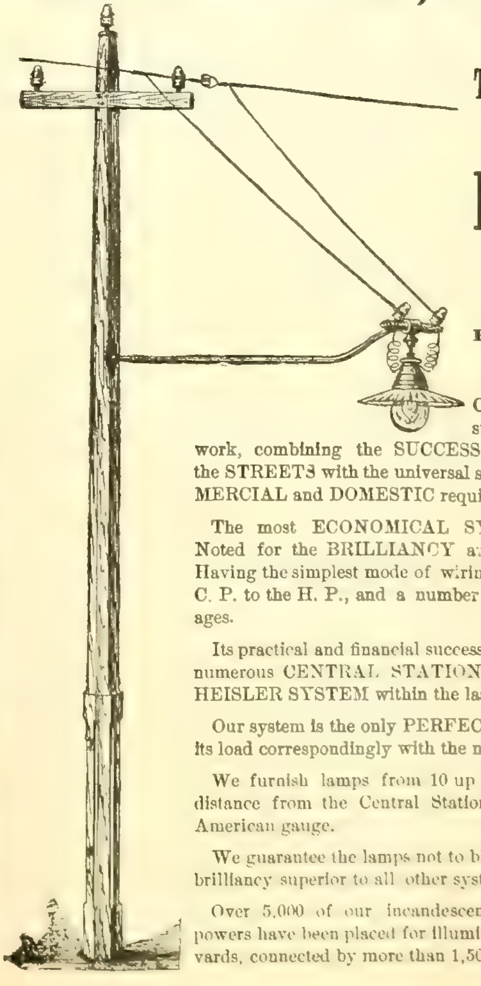

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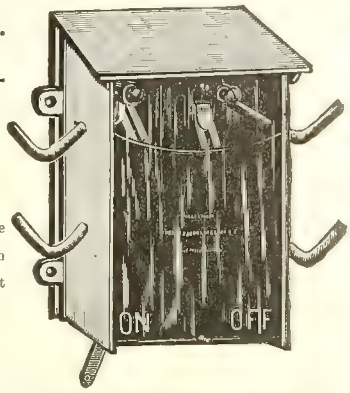

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Since the combination of the Westinghouse, Sawyer-Man, and the United States Electric Lighting Companies, and the Supreme Court decision in the Bates Refrigerator case (which the Edison Company endeavors to make capital of), these concerns have endeavored to completely submerge their competitors, by flooding the country with literature of such character as to mislead the public.

In order that prospective purchasers may become better acquainted with the true inwardness of this electric light controversy, and the history of the invention, we deem it no more than reasonable that we present a few facts, viz.:

1. Thomas A. Edison has not, nor ever had, the remotest possible claim to the priority of invention of the incandescent lamp, and his position is simply a pretense.

2. Walter K. Freeman was the original inventor, and made and sent to Thomas A. Edison the first incandescent lamp, with a high resistance carbon filament, that he (Edison) ever saw.

3. Edison never had a patent covering broadly the lamp; therefore, no such patent could be sustained in the courts.

4. The United States Electric Light Company has no claim for a patent; the only claim it ever had was based upon a contract with Walter K. Freeman, dated June 21, 1880, and which is now in litigation. The patents they quote are not essential or necessary for the successful manufacture or operation of incandescent lamps.

5. The Sawyer-Man patent, number 317,676, was not a new discovery, nor does it cover features necessary to the manufacture of an incandescent lamp.

All of the claims which these concerns make for patents, covering broadly the incandescent lamp inventions, are senseless and false, because the incandescent lamp did not originate with either of these companies, nor with any person or persons connected with them; they, therefore, have no rights in the premises.

A very pertinent fact regarding the successful operation of the present incandescent electric light system, viz.: The incandescent lamp itself, and the converter system of electric lighting, are the results of a series of experiments conducted by Walter K. Freeman, at Racine, Wis., where he had in operation, and continued to operate for more than twelve years the inventions that were then made, covering this method of lighting, thereby preserving the validity of his claims to such benefits as may be derived from his researches. His applications in the Patent Office, for patents covering broadly the idea of the alternating system, and the incandescent lamp, must be disposed of before any company can sustain its patents, or collect damages of any user of electric light apparatus.

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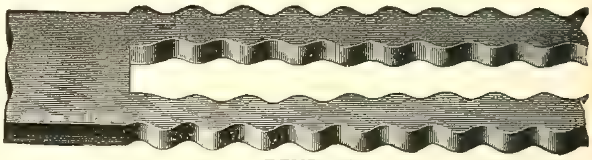

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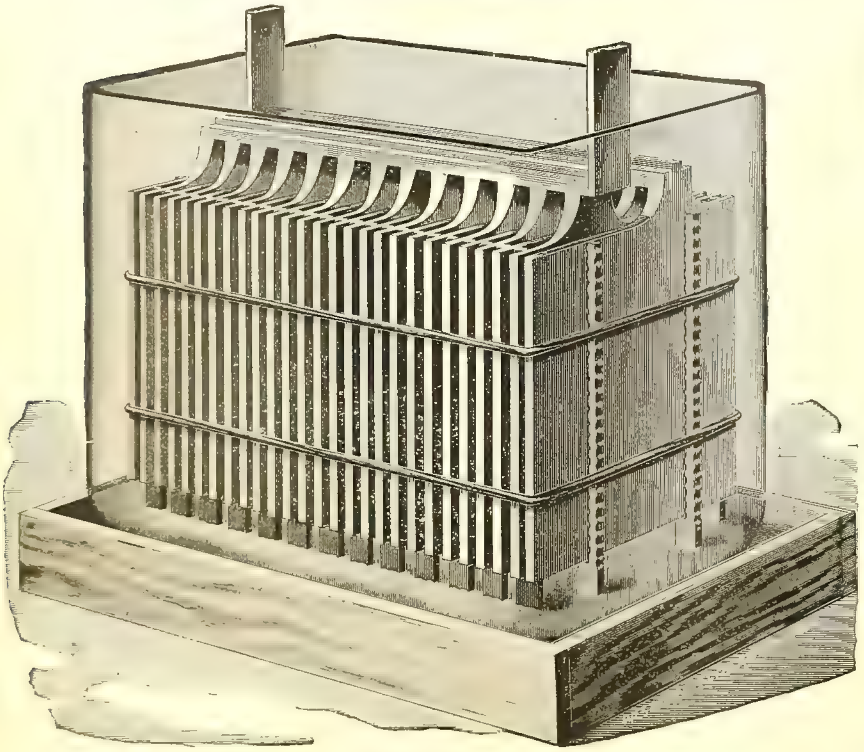

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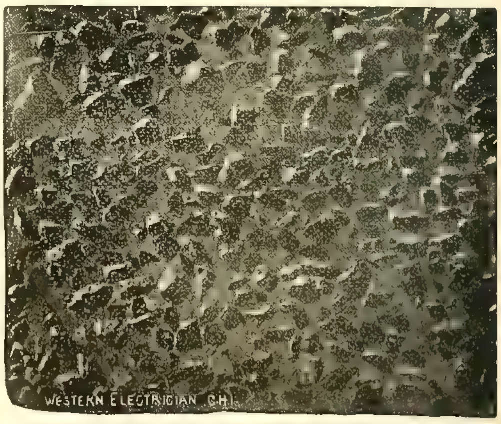

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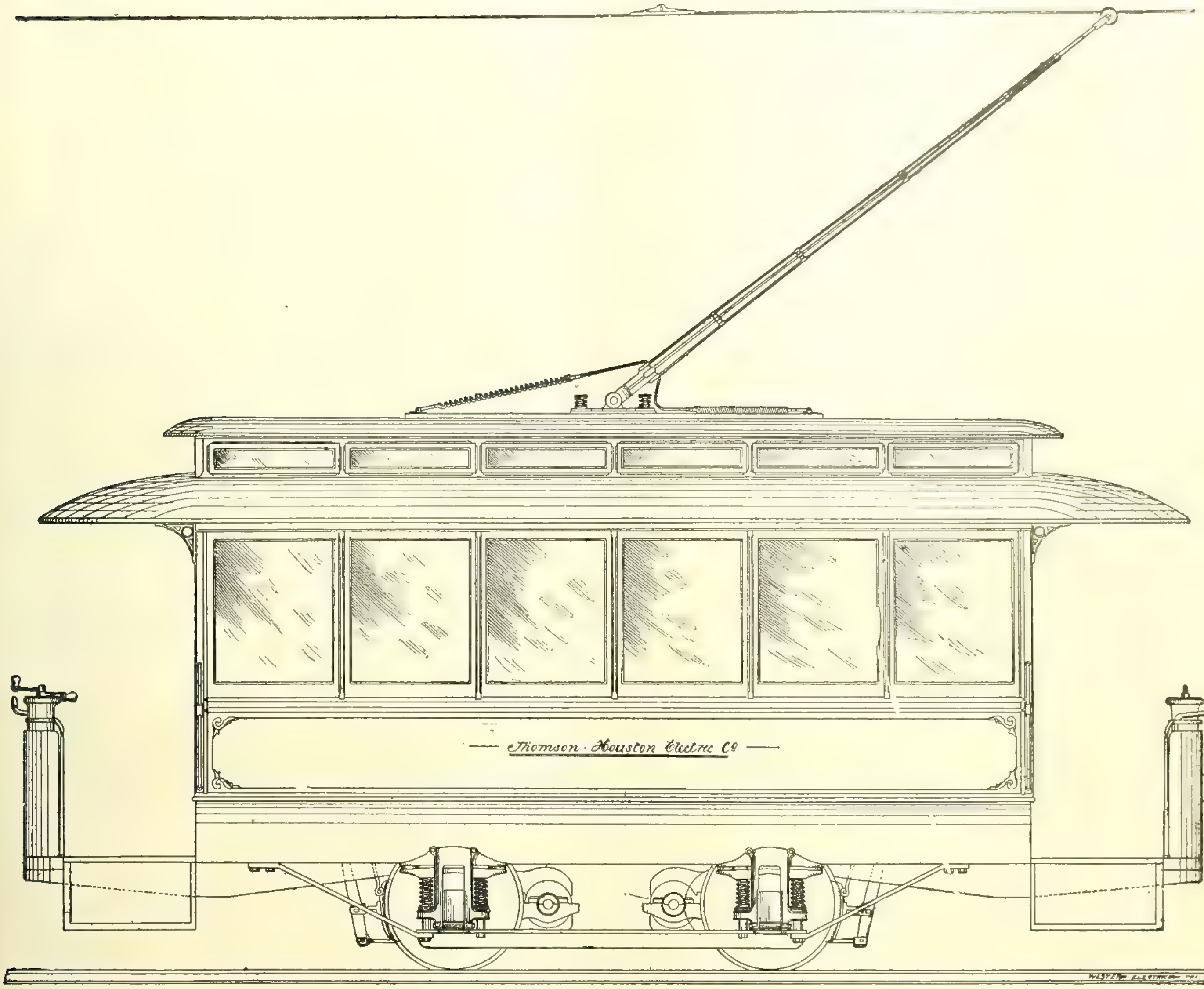

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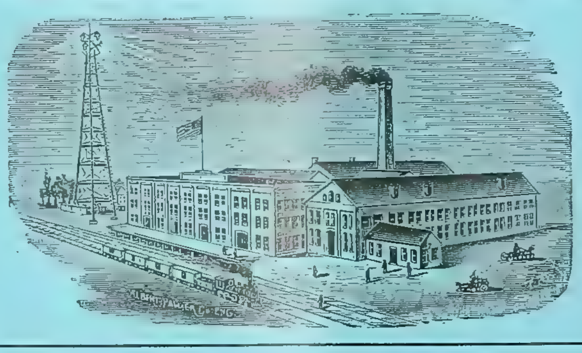

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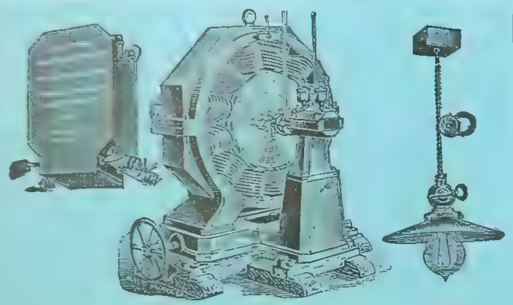

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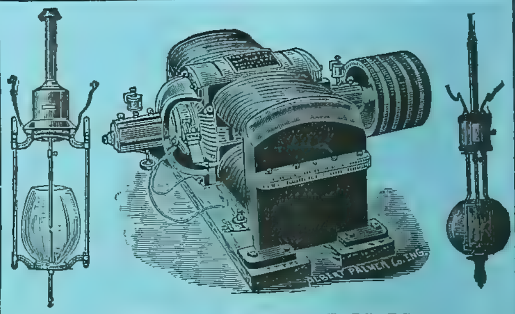

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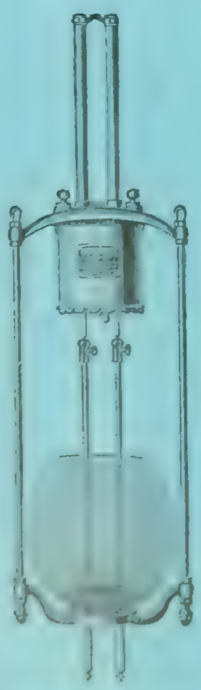

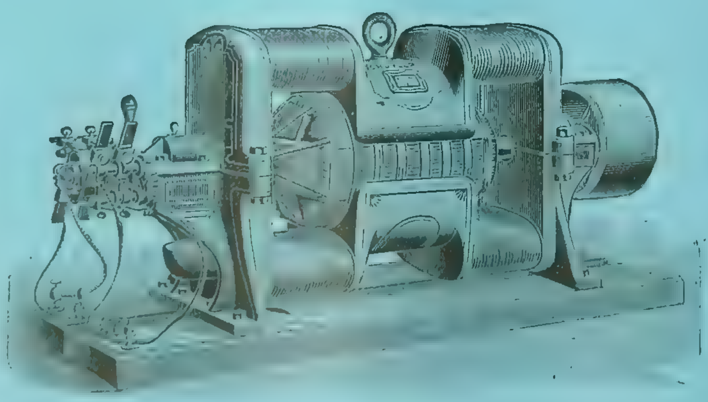

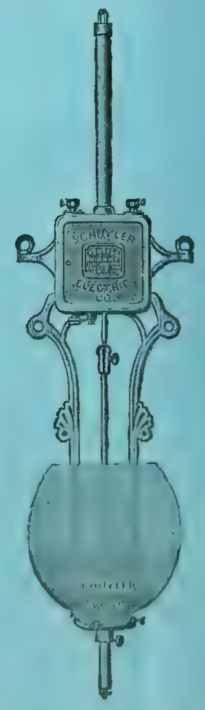

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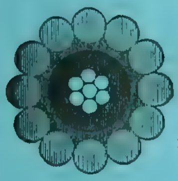

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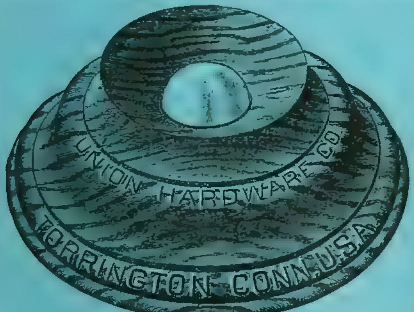

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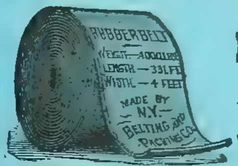

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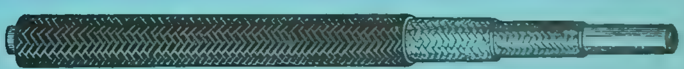

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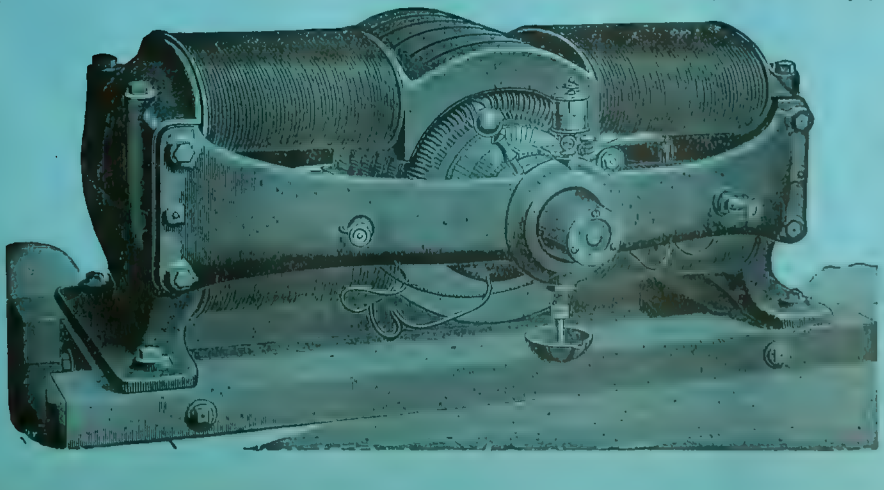

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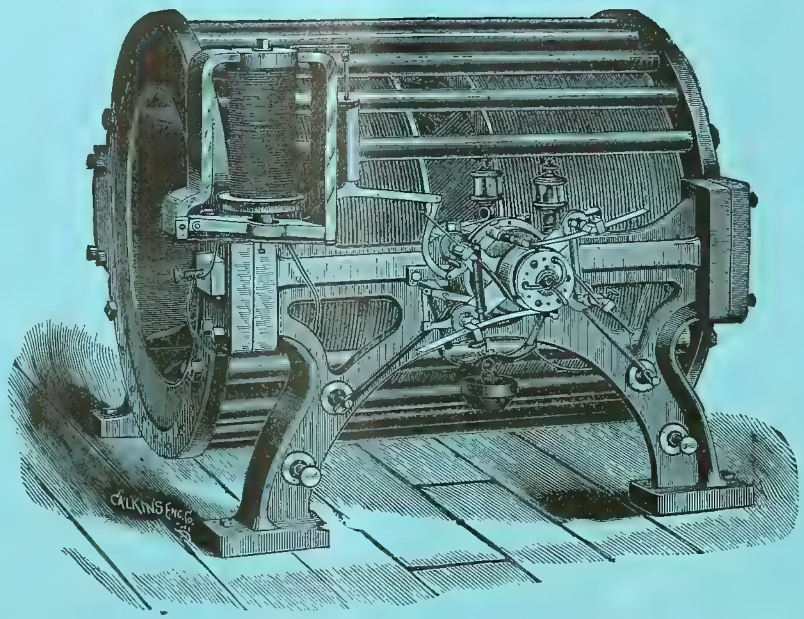

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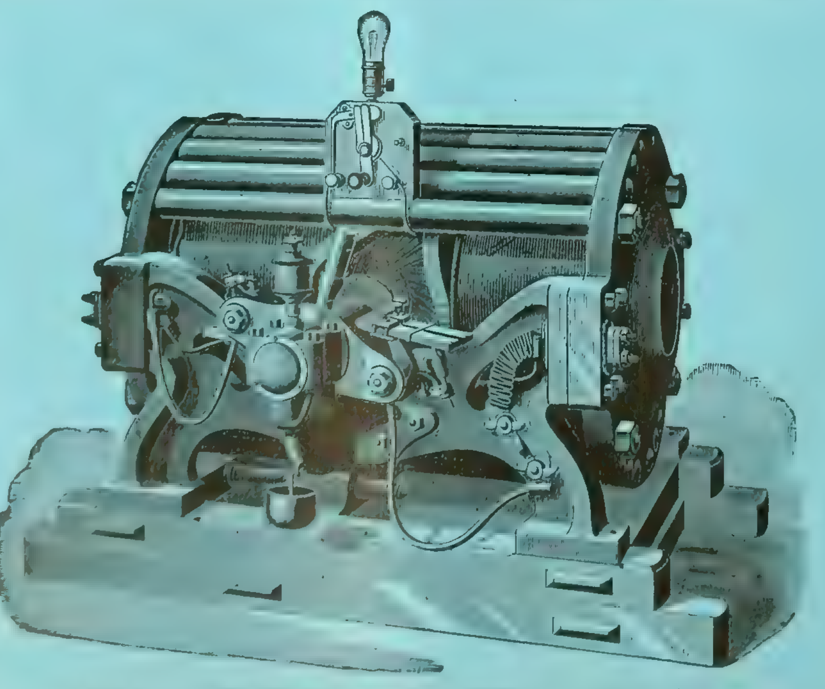

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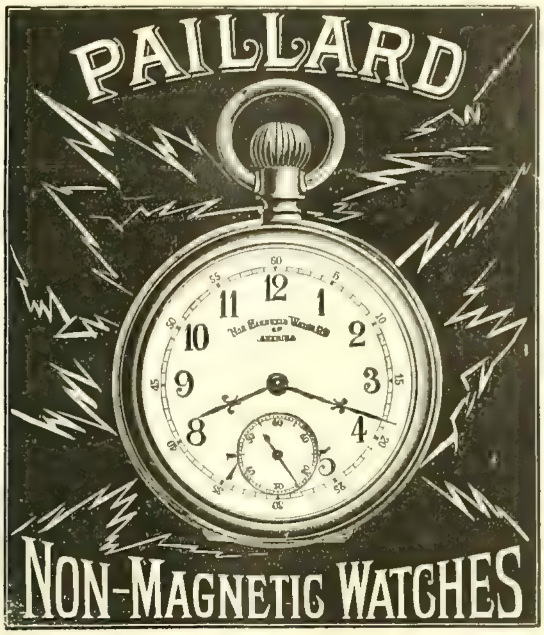

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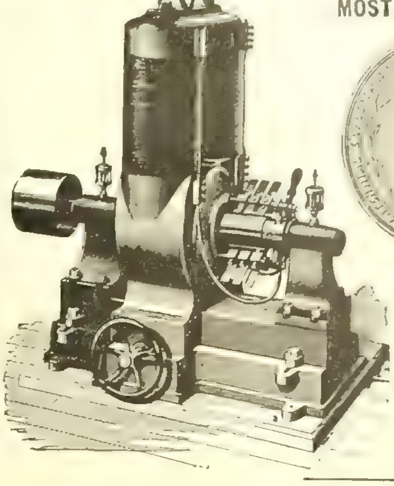

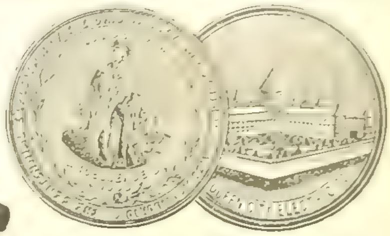

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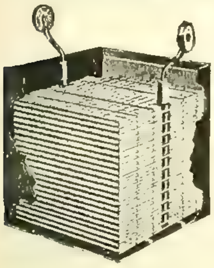

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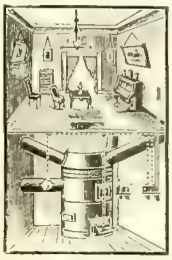

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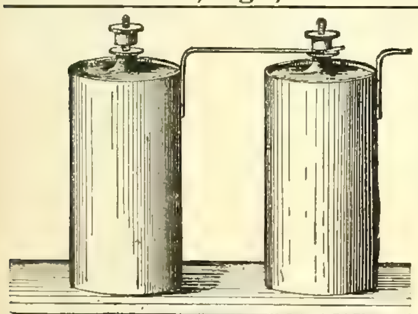

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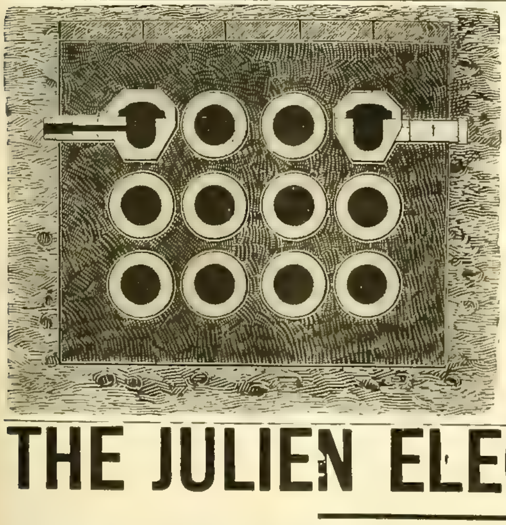

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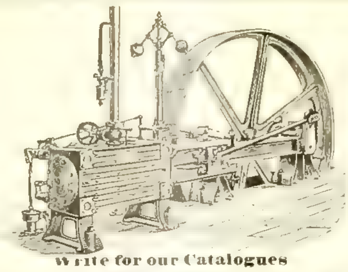
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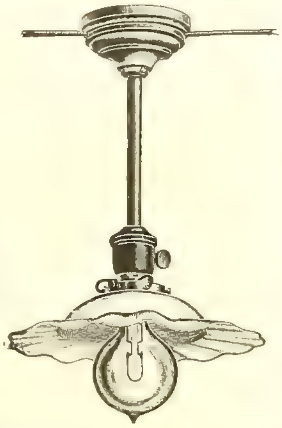

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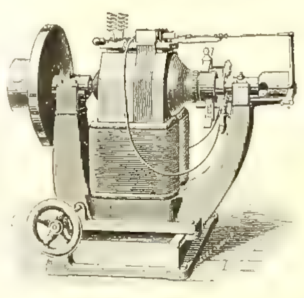

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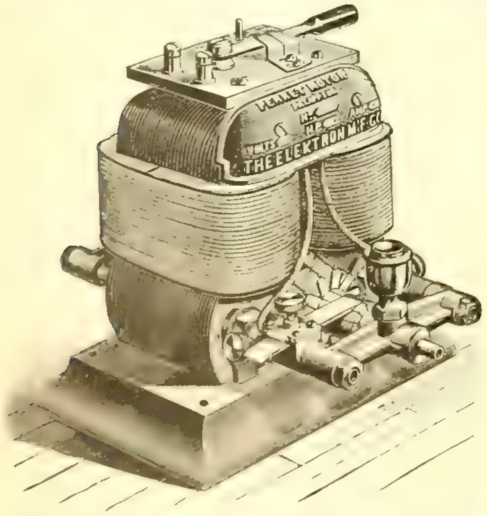

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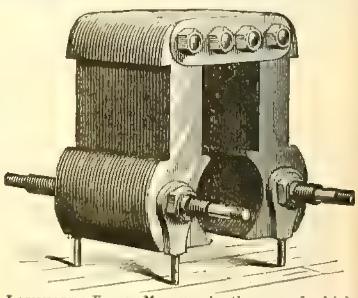
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Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

We have now only to prove the fact of infringement in order to secure prompt injunctions against, and damages from, those who have been so long using with impunity that which the HIGHEST AUTHORITY now concedes to have been ours, exclusively, from the beginning. This is simply to establish

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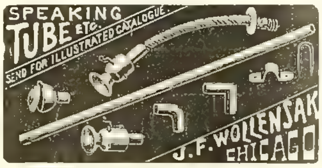

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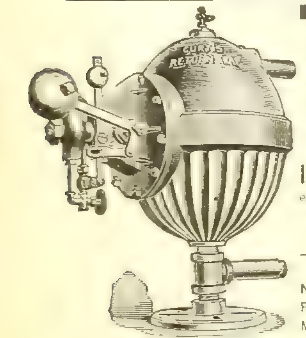

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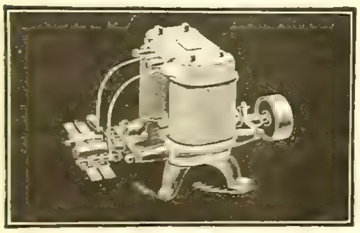

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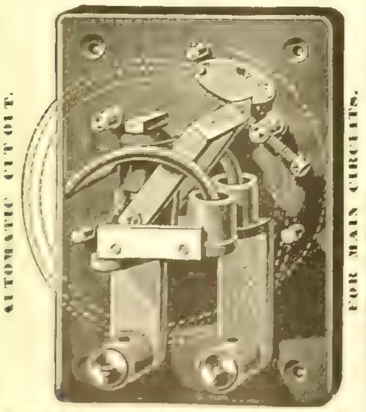

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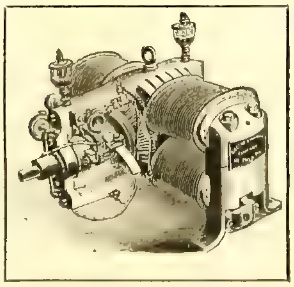

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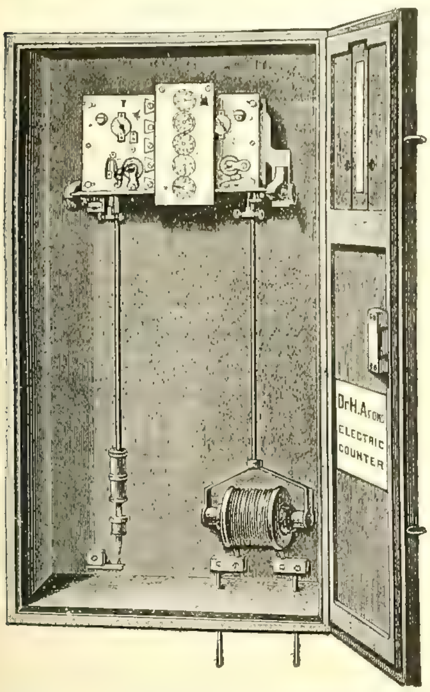

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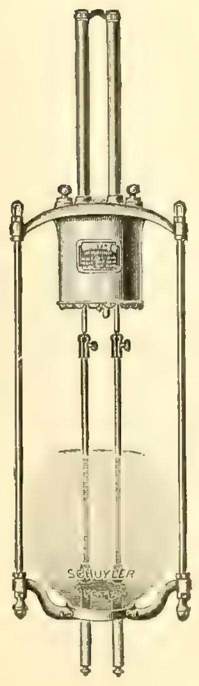

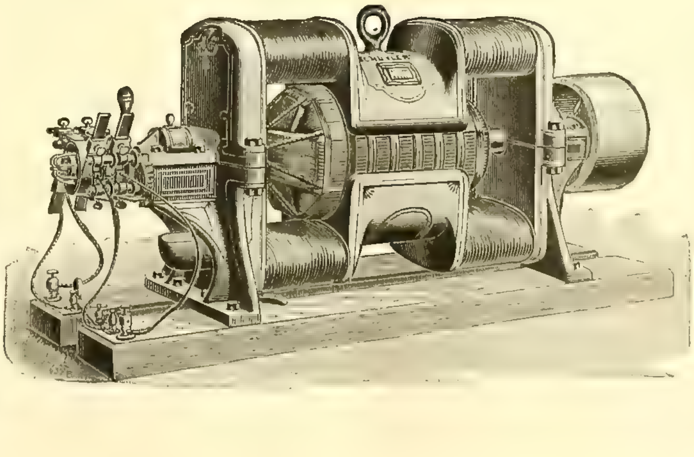

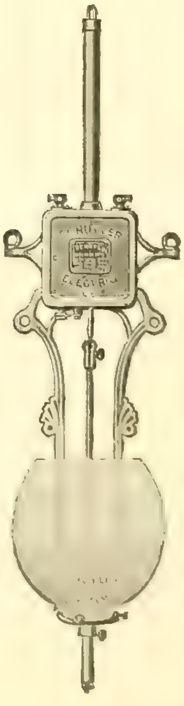

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Vol. IV. CHICAGO, JUNE 22, 1889. No. 25

Electrical Laboratory at Purdue University.

A prospective view of the new electrical laboratory, which is building at La Fayette, Ind., for Purdue University, is shown in the accompanying illustration. The diagrams show the floor plans of the institution. Purdue University is chiefly a school of mechanical and civil engineering. The institution possesses a well-equipped mechanical laboratory and a physical laboratory, well adapted to the needs of the school. The Indiana legislature at its last session made an appropriation for the purpose of establishing a school of electrical engineering. The laboratory when furnished and equipped will be one of the finest in the country devoted to this especial purpose. The first story will be of cut stone and the second of brick. It will be heated by the hot blast system, and the temperature will be governed by the Johnson regulator.

The building will be equipped with a large number of galvanometers, electrometers, voltmeters, resistance coils, bridges, ammeters, ampere balances, dynamometers, electro dynamometers, etc. Nearly all the typical forms of dynamos and motors will be placed in the dynamo room. These will include a Gramme incandescent, a Thomson-Houston arc, a Jenney incandescent, an Edison incandescent, a Brush arc, a compound wound incandescent, and an alternating dynamo, together with a number of typical motors. These will be run by a "Straight Line" engine manufactured by the M. C. Bullock company of LaFayette, Ind.

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ELECTRICAL LABORATORY OF PURDUE UNIVERSITY.

Death of William F. Swift.

William F. Swift, secretary of the Brush Electric company of Cleveland, O., died at his home in that city June 11th. He had been ill for several months, but until a few weeks ago it was hoped with confidence that he would recover. Mr. Smith was born in Ravenna, March 7, 1852. In 1867 he removed with his parents to Ashtabula, and soon afterward began his newspaper experience by acting as correspondent of the Cleveland *Herald*. His excellent work received proper recognition in 1872, when he was given a place on the local staff of that paper. He was in a short time made city editor, and soon afterward resigned to accept a situation with the Chicago *Inter-Ocean*. Six months' experience in Chicago was followed by his return to Cleveland, when he became city editor of the Sunday *Post*. He resumed the city editorship of the *Herald* a short time after. In 1880 he became city editor of the *Leader*, and less than a year later he accepted a position with the Brush Electric company. He first traveled in the South and in Mexico establishing electric light plants, and upon his return to Cleveland was elected secretary of the company. He spent the winter of 1887-88 in New York, establishing an eastern office of the company, and at that time he suffered severely from throat trouble. His lungs became affected, and from March to June, 1888, he was in Texas, and after a brief stay in Cleveland, following his return in June, he went to Santa Fe, N. M. He returned from Santa Fe five weeks ago, after having received assurances from the doctors there that his lungs were all right, but it was found upon his arrival in Cleveland that he was in the last stages of consumption. Mr. Swift was married to Miss Flora M. Chichester in Cleveland in 1879, and is survived by Mrs. Swift and three children. The funeral took place on the 14th inst.

When Electricity is a Nuisance.

Shocks of frictional electricity taken in the class room or laboratory from Leyden jars, etc., are interesting, and often amusing. When, however, a whole dynamo room is turned into a huge Leyden jar, and the mere act of touching the metal portions of the machines and fixtures furnishes a forcible illustration of the meaning of "difference in potential" most persons will admit that electricity might, sometimes, be called a nuisance. Soon after the incandescent plant in the Rookery building in Chicago was started it was discovered that the dynamos and other metal fixtures became so highly charged with frictional electricity from the large belts that the attendants were liable to receive severe shocks whenever they touched them. Besides this, the corrugated iron ceiling, just above and close to the running belts, would be coated with a black soot or dust, which seemed to be deposited by the electrical discharges from the belts. With a view of preventing this annoyance, the chief engineer of the plant, W. C. D. Gillespie, devised a scheme which, although old in principle, may be considered most effective in this particular case. Hanging from the ceiling, just over each belt, is a metal fixture shaped like an inverted T. Dangling from the horizontal portion of the T, and fringing it, are a number of small copper wires. This copper wire fringe over each belt is thoroughly insulated, and is electrically connected with the feed-water pipe of the boilers. By this arrangement as fast as the electricity is generated it is discharged into the fringe, through the conductor, and out to the ground.

Electrical Storms.

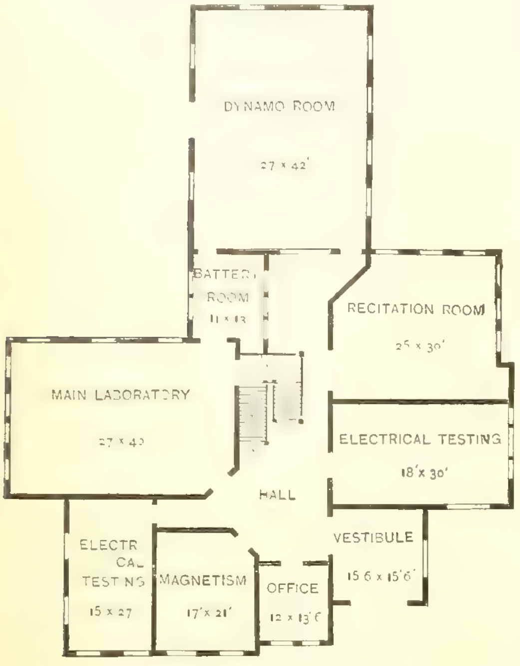
General electric storms [illegible] the country June 13th, and considerable property [illegible] destroyed. At New York [illegible] by lightning, and damaged [illegible] At Jersey City [illegible] the damage to surrounding property will exceed $25,000. A manufacturing building [illegible] part of the town was also destroyed, and the loss is estimated at $12,000. At Plainfield, N. J., a new church was struck—$2,000 will scarcely repair the damage. The telephone exchange was burned out. At this point there were three distinct electric storms within twenty-four hours, and residents of the town were filled with terror. At Newark there was a magnificent illumination, and many buildings were struck. Newark was visited before during the week, and it appears to be a favorite playground for lightning. Throughout New England considerable damage was done. The Hartford, Conn., opera house was struck while the theater was crowded, and although the lights were extinguished, no personal injury was sustained. Nearly every town in the state of Connecticut was visited by an electric storm, and in many considerable damage was done. Over 100 telephones were burned out at Pittsfield, Mass. Telegrams from Frederick, Md., announce considerable loss of life in that state. At Long Island city several persons were prostrated. St. Louis seems to have been the center of the storm in the West. Lightning played havoc with telephone wires, but little other damage was done.

Electric Power at Kearney, Neb.

In Kearney, Neb., is found an excellent illustration of the benefits of electricity in a new town adapted to manufacturing interests. Although Kearney is a young city it has surprised many of its more conservative rivals by its dash and enterprise. Since January 1st it has probably made more advancement comparatively than any other town in the state. It is admirably located on the Platte river, and has many advantages not shared by its neighbors. Its water power is immense, New England experts going so far as to claim that 20,000 horse power can be readily utilized at any time. The Kearney Electric company is furnishing electric light and power. The Thomson-Houston arc and Edison incandescent systems of lighting are employed. At present 30 arc lights are running, but the present plant will be enlarged so as to furnish double that number in a month. Already there is a demand for more arc lamps than the company can furnish, even when it has its new dynamo installed. A new water wheel will also be put in. The incandescent plant has a capacity of 4,500 lights. It was only recently installed [illegible] the company has not yet filled its orders. The Sprague Motor company has introduced a large number of its motors in this town and they are highly commended. Three [illegible] operated by these machines. A 75-horse power motor furnishes the power at the Kearney [illegible] works and the paper and woolen mills [illegible] operated in the same manner. A [illegible] tory has also adopted electricity and a packing house here recently introduced the same [illegible]

Each of these establishments has a 20-horse power Sprague motor. A wholesale grocery firm is using a 10 horse power motor for grinding coffees, spices, etc.

The Western Engineering company which recently removed from Lincoln to Kearney has done much to keep alive the enthusiasm in electrical matters. This company is constructing an electric road at St. Joseph, and is ex-



Plan of First Floor

ELECTRICAL LABORATORY OF PURDUE UNIVERSITY.

tending the present line in that city. The Salt Lake City Electric railway, Omaha's new electric railroad and the Plattsmouth Electric road will also be constructed by this company. An electric railway will be built at Kearney this summer. It will be 10 miles long, and an overhead system will undoubtedly be secured. The contract has not yet been awarded.

Electric Locomotive Headlight.

The accompanying cut illustrates an electric locomotive headlight, invented by W. L. Silvey of Lima, O. The object sought is to make a lamp that can not be jarred out of adjustment by the heaviest shocks of a locomotive. The lamp in question is operated by twenty-four cells of storage battery located on the engine. These cells are charged with energy enough to operate the lamp to its full capacity, 3,000 candle-power, for 12 hours. At the end of each division a 50 volt dynamo is located which serves the purpose of lighting the round house and shops, charging the cells for both the vestibule and passenger coaches and those for the headlights. The cells are of a new type. They will not buckle under a sudden change of output nor short-circuit in case the filling should drop out. The cells can be taken off the engine and replaced by freshly charged cells in about ten minutes. While an engine is waiting or making a short stop a renewal of cells can be effected, and the lamp is ready for further service.

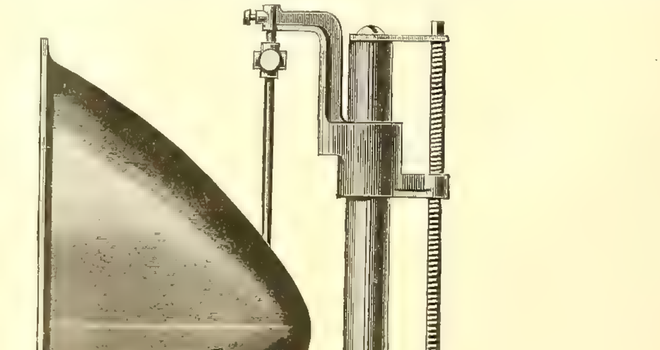
Attempts have been to supply electric head [illegible] a small dynamo, coupled direct to a small engine of three cylin- [illegible] machinery [illegible] by railway mechanics, and this, together with the necessary [illegible] of the dynamo or [illegible] this method [illegible]. The storage system, how- [illegible] as there are no moving parts; the only thing necessary is to [illegible] cells are properly charged and [illegible]

The novel feature of the entire equipment is the lamp. This consists essentially of a [illegible]

turns. This screw has two sized threads cut on it; the top for a distance of 12 inches has 8 threads to the inch, and the bottom for a distance of 6 inches has 16 threads to the inch; as these screws have right and left hand threads, it is obvious that they may be made to travel toward each other by turning the screw in one direction only. On the lower end of the screw there is fastened a ratchet wheel four inches in diameter, having 400 teeth cut in its periphery. On top of this ratchet wheel, pivoted at its center on the screw spindle, is a centrally balanced ratchet lever, to one end of which is fastened a small ratchet or pawl. This, at each operation or forward movement of the lever, engages with a tooth in the wheel pushing it forward. As soon as the forward motion has been completed the current is broken in the small electro magnet which performs this operation and the lever is at once drawn back by a spring engaging with another tooth, in this way establishing the arc or feeding the carbons. At each stroke of the ratchet and armature bar, the screw advances the carbons toward each other four one-thousandths of an inch, so that the carbons are feeding almost continuously. As the ratchet lever or armature is almost perfectly balanced horizontally and the carbons are secured to a solid screw vertically, the heaviest shocks have little or no effect on the feed of the carbons and no amount of jolting can possibly jar the carbons together, so that a perfectly steady light can be obtained at all times. The small magnets which perform the feeding are in derived circuit around the arc, and consume only ½ of 1 per cent. of the current used in the arc so that there is no oxidation at the platinum points in the circuit breaker. During the time it has been in operation it has been entirely satisfactory. Mr. Silvey has devoted a great deal of time to perfecting this apparatus extending over a period of over four years until to-day the apparatus works admirably.

Inspection of Electrical Apparatus.

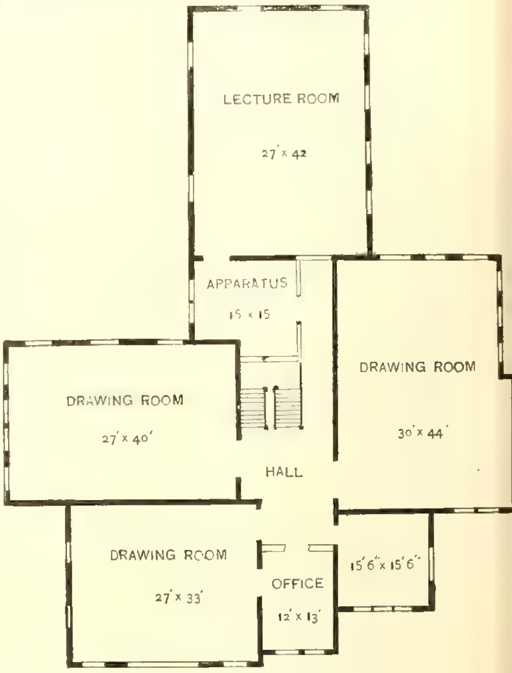
In conversation with a representative of the Western Electrician an electrical engineer recently gave expression to decided views on the subject of inspecting electric light wires and apparatus. While he was unwilling that his name should be used, he did not object to the



SILVEY'S LOCOMOTIVE HEADLIGHT.

publication of the main points in the interview. His views will probably not meet the approval of all electric [illegible], but as the subject is one which is exciting considerable interest, they are [illegible]. He said:

"The [illegible] number of electric light and power [illegible] the high tension systems to distribute current constitute a most substantial proof that the 'deadly current' has come to stay. Naturally enough, the low tension men, in the early days of electric lighting, endeavored to retard the advance of such systems. It was a matter of business with them, but it did not stop their progress. The high tension systems have as distinct a place to fill as have the low tension incandescent systems.



Plan of Second Floor

ELECTRICAL LABORATORY OF PURDUE UNIVERSITY.

"Suppose a few men have been killed by high tension currents, does this warrant legislatures in determining the maximum point of pressure? They may make it safe to handle bare wires, but they will at the same time destroy that particular feature which makes it possible to distribute over large areas at little loss. What is needed is not legislation to exclude high tension systems. Such action would be absurd. They are too useful for that. We need, in my opinion, laws for regulation, not exclusion. It is not difficult to so insulate and protect high tension wires and apparatus as to make accidents almost impossible, except to experts. Sometimes experts grow careless, and for that reason they are liable to injury. But experts under-

take their work with a full understanding of its dangerous character, and hence must take their chances, if they fail to exercise proper precaution. See what other forms of apparatus there are which we take little notice of, but which, in their way, might be considered just as dangerous as arc lighting machinery. Why is it that we hear, comparatively speaking, of so few accidents from falling elevators, bursting boilers, falling buildings, etc. For the simple reason that the law in most cases provides us with competent inspectors, whose duty it is to periodically inspect and enforce certain standards of safety.

"It is a strange fact," continued the speaker, "and one with a direct bearing on this subject, that all through the country incandescent wires carrying currents, say, of only 220 volts' pressure are, as a rule, run into buildings with greater care, and receive more attention from the companies whose current they distribute, than do the more dangerous arc light wires. A tour of inspection with a well posted lineman will satisfy any who doubt the above assertion.

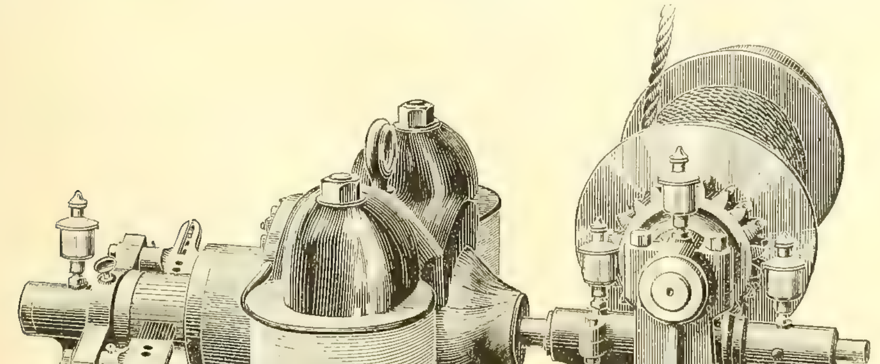
"We rarely hear of an elevator falling. Why? In all of our passenger elevators we see hung a certificate of inspection. This means that a competent, practical man has carefully inspected the machinery, and has pronounced it safe to carry a certain load. The fact that an inspection is to be made of itself makes men more careful in their work.

"The city fathers then should not attempt to exclude high tension systems, but should control their introduction by having all wiring subjected, periodically, to the most critical and honest inspection, so that a certain safe standard of insulation and protection should be rigidly enforced. Some of our larger cities are, I believe, now following such a plan."

Electric Shell Hoist for War Vessels

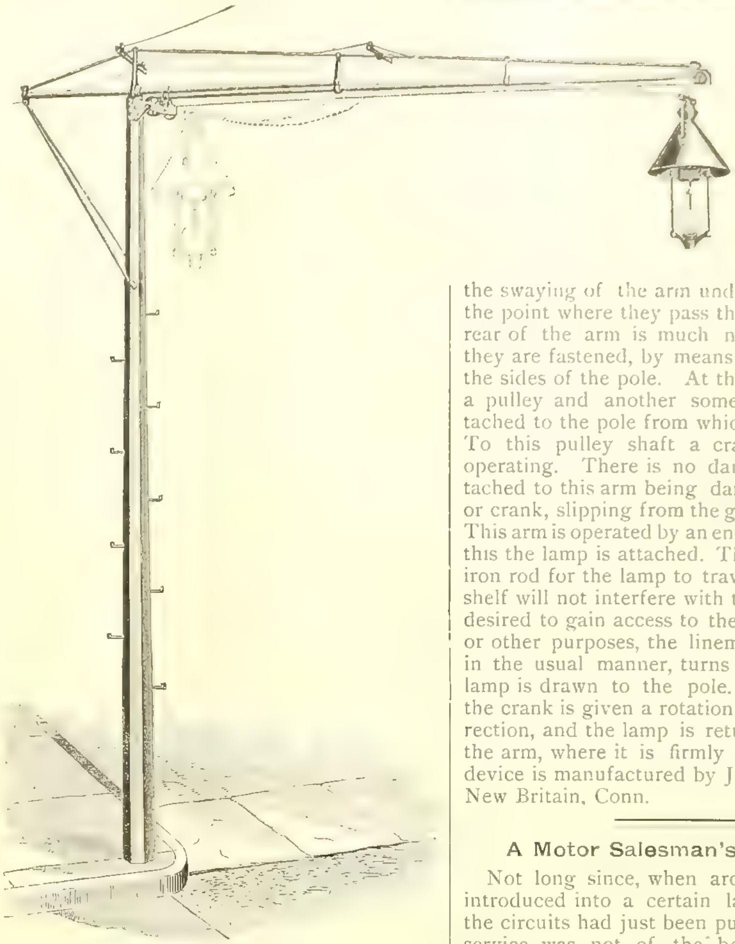
A view of one of the electric hoists built by the Sprague Electric Railway & Motor company, of New York, for the new United States cruiser Atlanta, is given in the accompanying cut. This hoist is the first of its kind built for this work by the use of electric power on shipboard and promises to extend rapidly. The advantages of electric power for the manifold uses on board vessels over transmission by steam, are many, and the general adoption of incandescent lighting on shipboard enables such motors to be operated without additional dynamo installation.

The hoist shown in the cut is of 3-horse power, using the regular Sprague graphite brushes, and can be run forward or backward with the greatest facility, by the simple movement in one direction or the other of an electric switch. By means of this same switch the speed can be varied to any degree desired.



SPRAGUE ELECTRIC SHELL HOIST FOR WAR VESSELS.

Although built for the special purpose of hoisting shells, this combination promises to meet a large demand for small hoists in manufacturing and other industries, where the small space occupied by an electric motor is quite a desideratum. The tendency among the leading electric supply companies, seems to be gradually toward electric motor combinations with other machines, like the above, and experience shows that such combinations create a demand as their advantages become recognized.



RENEHAN MAST ARM.

Renehan Mast Arm.

In the accompanying cut is illustrated the Renehan mast arm for suspending electric lights free from the foliage of shade trees that generally line the residences, streets and boulevards in large cities. It is made of wrought iron pipe and castings held in position by means of set screws. Iron bracings are used. From the pole, extending part way out the arm, a double pipe is used, as most of the strain plays on this point. The weight of the lamp and the long end of the arm are counteracted by the double rods and are transferred to a point down the pole; there- [illegible] the swaying of the arm under strong winds, as the point where they pass through the eye at the rear of the arm is much narrower than where they are fastened, by means of coach screws, to the sides of the pole. At the end of the arm is a pulley and another somewhat larger is attached to the pole from which the arm extends. To this pulley shaft a crank is attached for operating. There is no danger of the lamp attached to this arm being damaged by the lever or crank, slipping from the grasp of the lineman. This arm is operated by an endless wire rope. To this the lamp is attached. There is no groove or iron rod for the lamp to travel on therefore, the shelf will not interfere with the arm. When it is desired to gain access to the lamp for trimming, or other purposes, the lineman mounts the pole in the usual manner, turns the crank, and the lamp is drawn to the pole. After adjustment the crank is given a rotation in the opposite direction, and the lamp is returned to the end of the arm, where it is firmly held in place. The device is manufactured by James J. Renehan of New Britain, Conn.

A Motor Salesman's Explanation.

Not long since, when arc motors were first introduced into a certain large city, where, as the circuits had just been put underground, the service was not of the best, an enterprising motor salesman was hailed one morning by an irate coffee dealer. The latter's motor, on account of a "grounded" circuit, had refused to operate a coffee grinder. In forcible terms, the salesman was asked to explain why the machine stopped every day. With a bland smile the young salesman proceeded to explain that "the men at the station, just about that particular time, shoveled the ashes out of their voltmeters," and that if a little patience was exercised all would be well. It is needless to say the explanation was satisfactory.

A San Francisco Station.

M. W. Slater, who has charge of the electrical work for the Southern Pacific company, in San Francisco, was in Chicago last week. Mr. Slater has traveled throughout the east inspecting electric light stations to see the latest improvements which have been made. The Southern Pacific company proposes to erect a new electric light station, and if Mr. Slater's ideas are carried out power will be distributed from the same station to all the repair shops of the company.

Electric Motor for Elevator Work.

One of the latest of the installations of the Sprague Motor company in Chicago is that in the establishment of Lyon & Healy, 162 State street. The plant consists of a Sprague motor driving a Deane duplex pump, which forces water from a tank on the ground floor to a reservoir in the top story. The water thus stored supplies two hydraulic elevators—one passenger and one freight—and besides, is used throughout the building for various other purposes. The motor, 220 volt 10 horse power capacity, is snugly arranged on the lower floor, in a little room, built especially for it. It is lighted by an incandescent lamp. The motor room can be kept under lock and key, if desired. The motor belt passes out through slits in the wall to a counter shaft, which in turn belts to the large driving pulley of the pump. The capacity of

[illegible] gallons, but has been most of the time supplying 240 per minute. The reservoir at the top consists of two connected circular tanks, each of a capacity of 2,500 gallons. The plant throughout is most complete and its performance has been most satisfactory. A lighting plant of a capacity of 25 arc and 350 incandescent lights is shortly to be installed by the same firm.

Clark Arc Lighting System.

The accompanying illustrations show the new arc light apparatus of the Clark Electric company of New York. The dynamo shown in Figs. 1 and 2, it will be seen, has an unusually long and deep commutator, provided with two independent brushes on each side, either one of which is well able to carry the current. The brushes, therefore, may be changed or turned over while the machine is in operation. The shaft is made of cast steel and runs in gun metal bearings. The armature cores are made of iron wire, insulated with cotton and wound into the proper form. A better division of the iron is thus obtained, the manufacturers claim, than by making the cores of sheet iron rings with insulating material between them, but as the core in this method of construction is laminated in both directions instead of only in one, its magnetic resistance is somewhat increased, which is a serious objection to such cores in most machines. In these machines, however, the pole pieces of the field magnets are presented not only to the outside of the armature, but to its inner surface as well, and by this means an enormous increase of the polar surface is secured, which is claimed to render the wire cores of these machines more [illegible] core. The machines [illegible] claimed are the only [illegible] so constructed. It is stated that after a long run no portion of the machine is ever found uncomfortably warm. [illegible] Figs. 3 and 4 are [illegible] heads or other [illegible] t them. The binding posts are [illegible] and not be [illegible] or [illegible]. The [illegible] side of the case where it can be seen by the person operating it. [illegible] to the worst storms of the past winter, and although at times [illegible]

[illegible] regulator, [illegible]

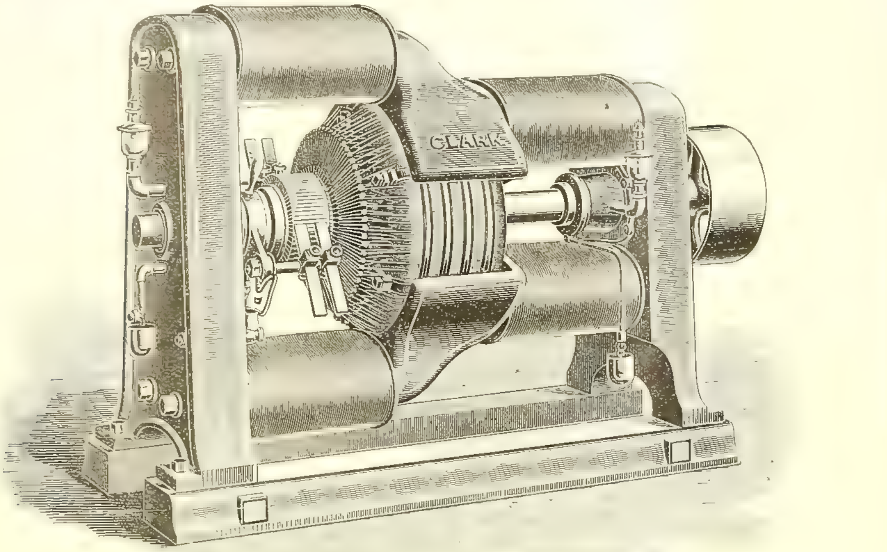


FIG. 1. CLARK ARC LIGHT SYSTEM.

justable counter electromotive force. This is accomplished as follows: The small Siemens-wound armature shown in the cut is included by means of its brushes and commutator in the field magnet circuit of the dynamo. The armature is wound with a large number of turns of small wire; as the current passing through it is very small—in the arc machines never exceeding 4-10 of an ampere. The armature revolves in the field as shown, and when the current passes, it becomes a motor, and of course sets up a counter electromotive force; the amount of which will depend upon the velocity of revolution of the armature, and the strength of the field in which it revolves. The speed of the armature is limited to a certain number of revolutions per minute, by means of a small belt running from the pulley on the armature shaft to another one on the dynamo, or a line shaft or some other revolving shaft, whose speed is constant. As the speed of the armature cannot change, its counter e. m. f. can only change by reason of a change in the magnetic strength of its field magnets. The main current on its way to the line passes through the coils of the regulator field magnets, and thus supplies the field in which the regulator armature revolves. If

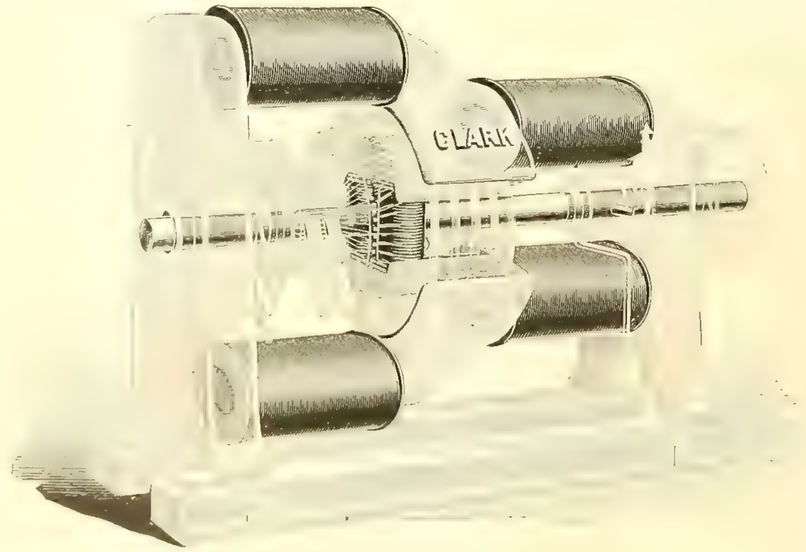


FIG. 2. CLARK ARC LIGHT SYSTEM.—INTERIOR FIELD.

from any cause the main current should increase in strength, it will at once cause an increase in the power of the field of the regulator, and an increase in the counter e. m. f. of its armature, [illegible] to the exciting current of the dynamo [illegible] reduces that current at once, and [illegible] of the magnetic field of the dynamo [illegible] reduces the generating power of the dynamo, and brings the current [illegible] to its standard strength. If [illegible] the main current should de[illegible], the opposite action will take place [illegible] field magnet decreas-ing in strength, the counter e. m. f. of its armature diminishing, and the current through it and the field magnets of the dynamo increasing, thus restoring the strength of the main current. There is another piece of apparatus included in the regulator, and shown at the back of the cut. It consists of a solenoid, located in the main circuit, whose armature is attached to a lever. The other end of this lever carries a sliding contact piece, which slides over a number of sections or contacts of copper. A number of small spiral coils of German silver wire are connected to these contacts, and arranged so as to form an adjustable shunt for the field coil of the regulator, whose resistance in the 30 light machine is only 15-100 of an ohm. By means of this arrangement, when the main current falls slightly, the resistance of the shunt is diminished, and a greater portion of the main current passes through the German silver coils instead of through the field magnet coils. This, of course, causes a further reduction of the magnetism of the regulator field magnets, the reverse action taking place when the current rises. It will be seen by this description that the regulating power depends upon the disturbance which is to be corrected, and the greater the disturbance the greater is the regulating power, and as it is not necessary that anything should move, the regulating influence can be exercised to a great extent instantaneously, while the entire power of the regulator can be exerted in the fraction of a second that is required for the lever of the solenoid armature to move. It is stated that the 30 light regulator exerts a counter e. m. f. under extreme variations of the main current, ranging from 3 or 4 volts to 700 volts, which is enough to control the dynamo under the most violent changes of load, and as there is no train of gears nor ratchet movements to be put in motion, the regulation is accomplished in much less time than with any other device in use.

The simple form of ammeter, used in connection with the Clark system, is shown in Fig. 6.

Incandescent Wiring Table.[1]

In the supplement accompanying this number of the WESTERN ELECTRICIAN is presented a wiring table for 110 volt lamps, which it is thought will be examined with interest by every reader engaged in practical electrical work. The table is taken from F. B. Badt's "Incandescent Wiring Hand-Book" which is now on the press. The little book is published to meet the requirements of incandescent wiremen, but it will be found to contain a large amount of information of value to every one interested in incandescent electric lighting. It explains in simple form all the problems which are likely to be met in the wiring of buildings, and abounds in practical suggestions. Three large tables are presented in the book similar in size to that in the supplement. They contain electrical data for all lamps of standard voltage.

[1] Incandescent Wiring Hand-Book, by F. B. Badt, pocket size, cloth [illegible], thirty [illegible] and [illegible] tables, three of which are [illegible] inches, [illegible] price [illegible], ELECTRICIAN Publishing Company, Chicago.

An explanation of the mode of using the 110 volt table which is given in the supplement is found in the following extract from the book:

We find in the horizontal columns at the top and bottom numbers which correspond to "lamp feet." (Lamp feet is a brief expression used to denote the product obtained by multiplying the number of lamps by the distance in feet.) At the left of the table we find three vertical columns filled with figures representing circular mils and also underlined figures giving the number of the Brown & Sharpe gauge. Each horizontal column corresponds to a

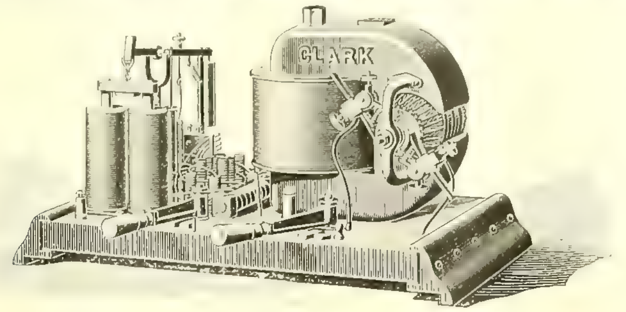


FIG. 3. CLARK ARC LIGHT SYSTEM.—AUTOMATIC REGULATOR.

vertical column. The radial lines starting near the left lower corner represent percentages of loss. Each small space in the inside columns represents 2,000, in the middle column 500, and in the outside columns 125; that is to say, in the horizontal columns the numbers represent lamp-feet; in the vertical columns the numbers represent circular mils, except where underscored, when they represent the number of the wire according to the Brown & Sharpe gauge. Although the difference would be very slight in any case it is necessary to state for those who may desire absolute accuracy in determining circular mils that the short heavy lines below the Brown & Sharpe gauge figures in the vertical columns are the correct gauge lines and may be understood as extending the full width of the table. The figures given in the columns represent thousands. For instance 100 denotes 100,000, 4.25=4,250, 2 5=2,500, etc.

Example: Find the size of wire for 100 110 volt lamps at 1,000 feet distance at 10 % loss.

Demonstration: 100×1,000=100,000 lamp feet. We find 100 in the inside horizontal column; we follow the vertical 100 line until it intersects the 10% line. We take a ruler and lay it horizontally through this point and find it strikes about 88 in the inside vertical column. The proper size of wire has a sectional area of 88,000 circular mils. If we wish to wire at 5 % loss we follow the vertical 100 line until it intersects with the 5% line and obtain by laying a horizontal line through this point, about 186,000 circular mils.

From this demonstration we deduct the following general rule for computing from wire tables.

RULE 13. Find the number of lamp-feet (lamps × feet) in one of the horizontal columns, follow the vertical line until it intersects the desired percentage line. A horizontal line laid through this point will show in the corresponding vertical column the cross section of the wire in circular mils. In consulting the table always use corresponding columns. If the lamp-feet are found in the middle column the circular mils must be read from the middle column; if the lamp feet are found in the outside column, the circular mils must be read from the outside column, etc.

EXAMPLE: Find the size of wire for 20 110 volt lamps at 900 feet distance at 5% loss.

Demonstration:—20 × 900=18,000.

We find 18 in the middle horizontal column; we follow the vertical 18 line until it intersects with the 5% line and following the horizontal line we find in the middle column about 33,500 circular mils.

EXAMPLE: Find the size of wire for 50 110 volt lamps at 100 feet distance at 5% loss.

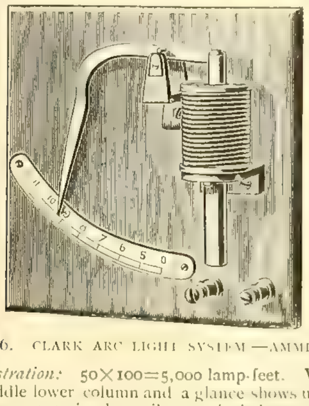


FIG. 6. CLARK ARC LIGHT SYSTEM.—AMMETER.

Demonstration: 50×100=5,000 lamp-feet. We find 5 in the middle lower column and a glance shows us that the wire is over 9,300 circular mils, or a little larger than No. 11 Brown & Sharpe gauge. We can find the same result by taking 5,000 in the outside horizontal column.

RULE 14. The number of lamp-feet within moderate numbers can always be found in one of the three horizontal columns. Select the one which will intersect with the desired percentage line farthest from the left lower corner. If the number of lamp feet is too great and cannot be found in the table divide it by 10, and find the circular mils for $\frac{1}{10}$ the number of lamp feet first and then multiply the result by 10.

EXAMPLE: Find the size of wire for 1,000 110 volt lamps 1,000 feet distance at 10 % loss.

Demonstration: 1,000 × 1,000 = [illegible] lamp feet. Divide by 10 [illegible] lamp feet [illegible] 10,000 lamp feet [illegible] circular mils [illegible] 100,000 [illegible] lamp feet [illegible] 000 circular mils.

Incorporated Executioners.

Stephen Lawson, M. E. Clear and Jacob A. E. Itlert have organized the American Executing company of Chicago, capital stock $25,000. It is the intention of the company to hire professional executioners for the purpose of conducting hangings and electrical executions. The fact that sheriffs do not like to officiate upon these occasions has given the opportunity to form this company. The members claim that

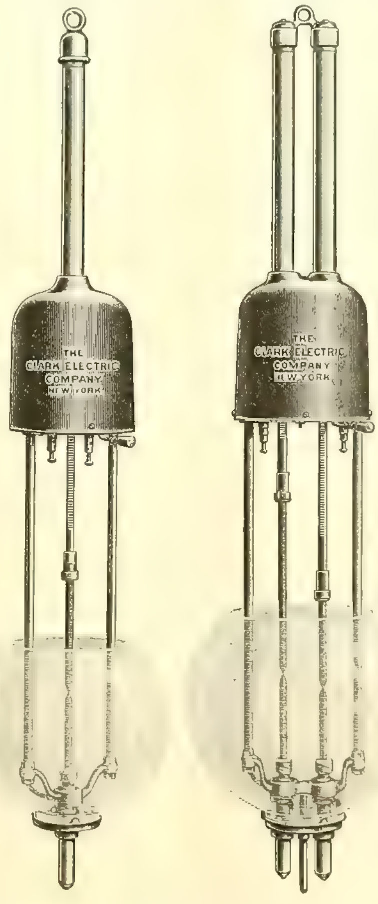


FIG. 3. FIG. 4

CLARK ARC LIGHT SYSTEM.

they have secured encouragement, and that they "hope to make a good thing of it."

Electric Current Regulator

A cheap instrument for regulating electric lights has been patented by Frank J. Crouch, and is illustrated herewith, says the *Scientific American*. A vessel is employed containing a saline or other chemical solution. In connection are diverging conducting arms connected in circuit with the main line and insulated, a central arm being adapted to be lowered into the solution to any desired depth, the brilliancy of the light being decreased or increased as the central rod is raised or lowered. Binding posts are secured to the cover of the vessel and insulated therefrom, and a transverse shaft, with a central pinion and a thumbscrew at one end, is jour-

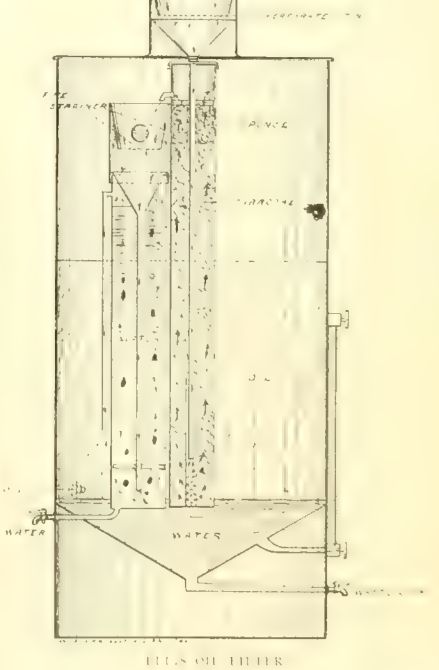
[illegible]

ELECTRIC CURRENT REGULATOR.

the electric light system is connected to the binding posts, completing the circuit through the spring conducting arms and the solution in which they are immersed. A shunt circuit connects the wires of the system, this circuit having a resistance coil made to balance the lamps used on the circuit, and the coil having a switch, shown in the small figure, to cut off communication between the coil and the shunt circuit.

The Ellis Oil Filter.

The accompanying cut shows the internal arrangement of the new Ellis oil filter. The oil, when first poured in at the top, passes through a coarse perforated tin diaphragm, and thence down a tube, as shown. From that point it works its way through charcoal. On top of the charcoal is packed a layer of sponge, held in place by a spider. After leaving the sponge the



ELLIS OIL FILTER

oil overflows into another strainer with very fine meshes, and thence is carried by another tube down to the bottom of the water vessel. The oil being lighter than the water, it then rises to the top, and is discharged into the main reservoir, ready for use. The different vessels containing the filtering material, water, etc., are so arranged as to be easily removed for packing, cleaning, etc. This filter was designed by D. R. Ellis, and is put on the market by the Electric Supply company, Chicago.

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W. A. KREIDLER, Editor and Publisher.
J. W. DICKERSON, } Associate Editors.
T. B. O'HARA, }
A. C. DURBOROW, JR., Business Manager.

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CORRESPONDENCE relating to electricity, or any of its practical applications, is cordially invited, and the co-operation of all electrical thinkers and workers earnestly desired. Clear, concise, well written articles are especially welcome, and communications, views, news items, local newspaper clippings, or any information likely to interest electricians, will be thankfully received and cheerfully acknowledged.

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A REPORT of the last meeting of the American Train Dispatchers' association will be found in the Indianapolis letter.

THE news comes from London that there has been found in the Communal Library at Bologna a hitherto unknown treatise on electricity by Galvani. No authority is given for the statement, and as the Italian electrical papers do not speak of the discovery, there is a disposition to discredit the report.

THE [illegible] New York of adopting summary measures with companies maintaining [illegible] its influence throughout the country. In Cheboygan, Mich., the city council has adopted a reso- [illegible]

[illegible] left in [illegible]

to be found in the St. Louis daily papers, who published cuts illustrating the scene of the wreck. The suspended poles are among the most prominent objects in the pictures.

IN an interview in another column, an electrical engineer presents his views on the subject of the inspection of electric light plants. The point emphasized is that there should be a periodic inspection.

A ST. LOUIS paper is growing enthusiastic over the possibilities of electrical propulsion. It says: "Are we to be entirely rid of the cost of laying rails for cars? Probably not yet, but ere long. A system of electric carriages, self-guided as well as self-propelled, is sure of coming soon into use. Then we shall have aerial navigation, and between the two rapid transit is solved. The expense of travel will, at the same time, be reduced to a small fraction of its present cost."

THE incorporation of the American Executing company at Chicago, to execute criminals sentenced to death by the application of electricity or by the rope, is noted elsewhere. The incorporation is by no means a huge joke of the Mulhatton type, as several papers asserted, but the company is regularly organized. The formation of the company will probably be cited by some of our foreign friends as a grim illustration of American ability to turn everything to business advantage.

A LABORING man of Philadelphia has offered to submit himself as a subject for a test of the efficiency of electricity for inflicting capital punishment for $5,000. He explains that he has a wife and children, and his inability to support them suggested the desperate means of providing them with the comforts he could not secure. This sounds like one of the familiar stories which are told of Chinese paupers who for a modest recompense agree to substitute for criminals sentenced to death.

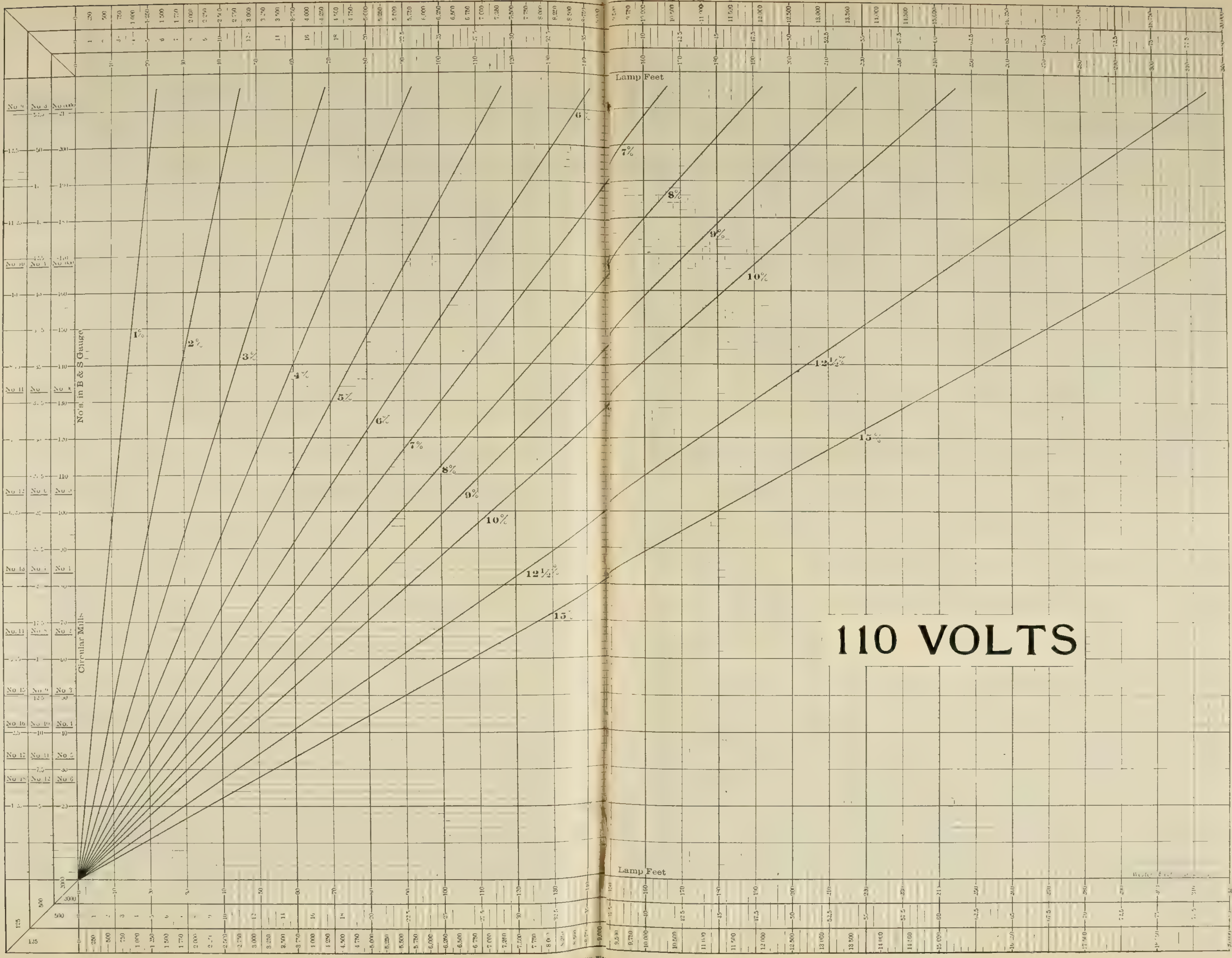
AN article reviewing briefly the life of Gaston Planté, who died in Paris last month, appears elsewhere in this issue. His work in connection with storage batteries will always make his name prominent in the history of modern electrical inventions. Planté gave his discoveries to the world, and others have reaped the benefits of his labors. It is stated, however, that his failure to apply for patents was not the result of a lack of appreciation of the importance of his discovery. He apparently thought it was the duty of a true scientist to publish his discoveries for the benefit of the world. Not many persons will share with Planté this belief, still one cannot fail to admire a man who believes and acts on this generous principle. Planté lived almost in retirement, and was much more at home in his laboratory than elsewhere. He approached, it has been said, quite nearly to the type of the ideal man of science.

THE new method of inflicting capital punishment in New York has had the effect of showing how little practical knowledge of electricity is possessed by the general public. The last evidence on this point appeared in a New York paper last week, when it printed an article from its Boston correspondent purporting to be an account of an accident which befell the superintendent of a Boston electric light company in 1885. It is evident the object of the writer was to show that the electric current was not "reliable" as a death dealing agent, and the incident referred to was certainly singular. It may be stated, however, that the article will not be considered valuable from a scientific standpoint, although it was extensively copied and discussed by the leading daily papers of the country. Singular enough, the papers that discussed the article fell into the same error as the correspondent. He claimed that the superintendent received a charge of electricity from a dynamo furnishing [illegible] power." While the physicians [illegible] to restore him he was [illegible] the dynamo room until [illegible] that he be removed to [illegible] the damp ground. The correspondent explains that the victim, while lying on the floor, was insulated, and that his body "contained" the enormous charge of electricity received from the dynamo. It is alleged that the man, when placed on the ground, began to revive, for the reason that the electricity was discharged gradually, the victim suffering the greatest agony as the current passed slowly from his body into the ground. This is certainly a revelation to all who have watched the development of electrical industries. Heretofore it has been the accepted belief that a current of electricity would pass instantly through the body, but now it appears that it has acquired the habit of loitering, that a human body can be utilized as a secondary battery, and, this conceded, an entirely new field is opened. It is to be regretted, however, that the learned Bostonian and his contemporaries of the daily press cannot be accepted as authority on this point.

CHAUNCEY M. DEPEW has recently communicated in the form of an interview, an answer to the question: "Can railroad travel ever be made entirely safe?" He answers the query in the negative, for the reason that a perfect system cannot be designed by man. Dangers can be made much less than at present, in his opinion. He is inclined to believe that in the future cars will be heated as well as lighted by electricity. He says: "The tendency at present is to employ steam heating. But besides this system are others which promise even better things. Electric storage batteries, electric stoves, chemical stoves and compression engines are among these novelties. One scientist has a plan whereby electricity is used as a fuel, so to speak, and is gathered up by the moving train just as the New York Central engines take up water when at full speed. The electricity is taken from a wire or other conductor alongside of the rails, is stored in accumulators on the train, and is converted into heat by a mysterious apparatus on board of each car."

FRANK G. CARPENTER, in a letter from India, thus speaks of the telegraph equipment in that country: The telegraph poles on many of the lines are hollow tubes of galvanized iron, about as big around as the average man's calf, so made that they fit into one another and form a pole about ten feet high. To these poles the lines were strung, and many of the roads use such poles throughout their entire length. On other lines the telegraph poles are T iron rails, the same as those on which the car travels. Two of these rails are fastened together by bars about a foot wide, and then this iron lattice work is set deep in the ground and the wire strung upon it. About some of the stations the fences are made of such iron rails, and through hundreds of miles long one of the rajah's railroads in western India I found fences of barbed wire with sandstone posts. These posts were a foot wide and four inches thick, and they stood about three feet above the ground. The wires ran through holes in them, and the railroad men tell me that they are much cheaper than wood.

SIR WILLIAM THOMSON recently read an interesting paper on "The security against disturbances of ships' compasses by electric lighting appliances." The necessity of employing precautionary methods is obvious, and the present discussion will have the effect of attracting more than ordinary attention to the subject, and securing thorough consideration of the systems now employed. Sir William Thomson advocates the abandonment of the single wire system with ship return except in alternating systems. On the other hand, Alexander Siemens states that in all his experience in single wire work, only one complaint had been made, and that was in a case where the location of the compass had not been determined when the wiring was done. As a proof that the single wire system could be made satisfactory, he mentioned that his firm makes inquiries on all vessels fitted by them every time they come into port, in order to ascertain whether any inconvenience arises from the electric lighting apparatus; but with the exception noted, no complaint had been made. The discussion will undoubtedly tend to improve the character of the installations.



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110 VOLT TABLE FROM INCANDESCENT WIRING HAND-BOOK NOW IN PRESS

Gaston Plante.

In current electrical literature one of the most familiar names is that of Gaston Planté, who died suddenly at Paris on May 24th. No article on the storage battery is complete without a statement to the effect that the principal work of Planté's life was his investigation into the voltmeter, the practical result of which was the invention of the storage cell with lead plates. Planté experimented upon all conceivable metals and combinations of metals to be used for electrodes in voltmeters, and the result of his numerous tests was to show that lead is, all things considered, the best active material from a practical point of view, though the amount of energy which he found possible to store per unit of weight was greater in the case of some other metals. Planté was born in 1834 at Orthez. His scientific studies were pursued at the Conservatoire des Arts et Metiers, in Paris. He took a position as a laboratory assistant, and soon began an investigation into the nature of electro-polarization, which led to the discovery of the accumulator.

The immediate cause which prompted him to undertake his first long series of investigations was not the desire to find a storage battery, because in those days the application of dynamos to electric lighting was still unknown; it was the desire to study the effects of electric discharges of great quantity, which were not attainable with frictional machines and Leyden jars. The discovery of the lead accumulator was, so to speak, a by-product of his investigation.

Planté continued for many years to add to the number of cells in his possession; he studied their progressive formation with keen interest, and as he had to rely chiefly upon the Bünsen battery for his charging current, the process was both tedious and costly. Many of his experiments on the discharge were of the most brilliant and even daring character. His eyesight almost failed him for a considerable time before his death, and the cause was ascribed to too close application to experimental work. He was by no means blind to the possibilities of the practical application of the lead battery, and among other suggestions for its use he referred at an early date to the electric light, although in an era before Swan and Edison were known, and when the dynamo was scarcely as yet a commercial machine. He was unable to foresee the full importance of the suggestion.

He also invented what he called the "machine rheostatique," being essentially a commutator which, on being turned by a crank, rapidly changed the grouping of the secondary cells from parallel to series. Of late years Planté devoted himself almost exclusively to the reproduction of meteorological phenomena in the laboratory by electrical effects, and he has succeeded in thus imitating hail, globular lightning, etc. His latest publication was a small book on this subject, printed a little over a year ago, and he has also contributed to the Exhibition at Paris some very interesting apparatus and specimens in connection with this work.

In 1881 M. Planté received the Diplome d'Honneur at the Paris Exhibition, and he was also made a Chevalier of the Lègion d'Honneur. A little later the Académie des Sciences conferred upon him the "Prix Lucaze," and he also received the Médaille d'Ampére from the Societé de Encouragement pour l'Industrie Nationale.

The honors which were showered upon M. Planté during the latter portion of his career did not induce him in any way to modify the quiet and retired life which he had led for so many years. Nearly his whole time was passed in his laboratory in the Rue des Tournelles, where, however, a kindly welcome was assured to every visitor, more especially to such as happened to take an interest in the pursuits in which his attention was absorbed.

Electric Lighting in a Chicago Theater.

The Academy of Music on Halsted street, Chicago, will be lighted next season by a Thomson-Houston system, both arc and incandescent lamps being used. H. R. Jacobs, proprietor of the theater, during a recent visit to Chicago, awarded the contract for the plant to the Thomson-Houston company. It will consist of 400 incandescent and 10 arc lamps. The Thomson-Houston company will introduce a plant in the Casino, which is also under Mr. Jacobs' management. Mr. Jacobs is [illegible] lighting in all the theaters under [illegible]

Chicago Electric Club.

The board of managers of the Chicago [illegible] the club recently adopted [illegible] Norman Williams of the Chicago Telephone company for placing a free telephone in the club rooms. A new house committee was [illegible], consisting of F. B. Badt, C. C. Haskins and G. O. Barry. It was decided that the [illegible] of the club should hereafter wear a club livery.

Board of Electrical Control.

At the last meeting of the New York board of Electrical Control, the Manhattan Electric Light company presented a letter in which it was set forth that the want of subways was seriously interfering with the development of its business, and it asked that subways be constructed in Forty-ninth and Fifty-seventh streets from First avenue to Broadway, in Fifth avenue, from Forty-second street to Fifty eighth, and in several other thoroughfares up town. It stated that a large number of subways had been ordered by the board which had not been constructed. Engineer Kearney then read a report showing proportion of work done to work ordered, and the board authorized the construction of conduits for telegraph and telephone wires on Fifty-eighth street, Tenth street, Dey street, Fourteenth street, and Sixteenth street Mayor Grant called attention to the appropriation that has been made for repaving the streets of the city, and urged that whatever tearing up was necessary should be done at once He said that the

GASTON PLANTÉ

subways should be constructed when the old pavements were torn up, and fully completed before the new pavements were laid down The commissioner of public works, Mr Gilroy, had been summoned by the mayor, and he named some of the streets to be repaved. The arrangement of the work of repaving and the construction of the new subways was referred to Commissioner Gilroy and Engineer Kearney, so that both operations might proceed harmoniously In connection with the laying of a subway for electric light wires in the Bowery and Third avenue, from Chatham street to the Harlem River, the mayor insisted that it must be effected before the Bowery is repaved, which is to be done shortly He thought that the Subway company would have no difficulty in digging trenches and completing their work within a week, so that the regrading and repaving could be completed. The commissioner of public works informed the board that the appropriation for removing poles and wires would be exhausted by July 10, and without additional funds the work must stop. The matter is to be reported to the board of estimate

The United States Illuminating company applied for a permit to erect twenty-nine poles on East Sixty-ninth street to connect with Jones' Wood, but the mayor strongly opposed the application, which was denied.

The Western Union company asked for permission to string wires on the elevated railroad structure on Greenwich street and upper Eighth and Ninth avenues, and after Mr. Humstone's explanation that it would make 400 of the company's poles available for removal, the permit was given.

A resolution was offered by Commissioner Gibbons to provide for replacing bad or dangerous poles with new ones at the discretion of their owners. The mayor was of the opinion that it would give too much latitude to the companies. The engineer was ordered to make an examination of damaged poles and to report to the board.

Work at the power house of the electric street railway line at Stillwater, Minn., is progressing rapidly. Water was put in the new boilers last week, the motors are being put on the cars, the dynamo is ready and so is the engine. A car was taken along the tracks last week to see that all switches worked right. The track is completed its whole length, and soon cars propelled by electricity will be running through the city.

The Babyhood of the Electric Telegraph.

[illegible]

fail or, having [illegible]

[illegible] ever in sight these cranks and knaves and fools, there are [illegible] world valuable, almost priceless, mechanisms; knaves [illegible] whose mental triumphs have been deemed worthy of commemoration [illegible] which have succeeded them.

The story of the telegraph, as we know it to-day, is a story of a slow progress through many centuries. The [illegible] savages from [illegible] intelligence by [illegible] telegraphic signals [illegible] upon the peaks of mountain ranges. It is reasonably certain that to a limited extent [illegible] communicated by this means, [illegible] or relative positions of these blazing signals

The semaphore, which wildly swings its arms like some ghostly [illegible], has a [illegible] for communication, and by a code may be made to cover a very considerable vocabulary. Again the flag signal system still farther elaborates this species of communication and is very complete for its specific purpose. But in telegraphy, what the world required, what the inventor sought, was a method of communicating thought without hindrance or complication, which required no dictionary, no translation, and which should be universal in its application, available to all

The ideas which led up to this through the channels of electricity and magnetism are interesting and curious. One of these dates as far back as 1617. In that year Strada mentioned in a Romish publication that there was a possibility of two parties conversing by means of loadstones and needles suspended over lettered dials.

Half a century afterward this idea is again recorded, and Sir Thomas Browne said of it that "the [illegible] was widespread throughout the world; and that while the credulous and the vulgar readily accepted it better minds did not altogether reject it." "The conceit," said he, "is excellent, and if the effect would follow, somewhat divine; it is pretended that from the sympathy of two needles touched with the same loadstone, and placed in the center of two rings, with letters described round about them, one friend keeping one and another keeping the other, and agreeing upon the hour when they will communicate, at what distance of place soever, when one needle shall be removed unto another letter, the other, by wonderful sympathy, will move unto the same."

Sir Thomas was so impressed with the possibility of success that he actually made the experiment and of course failed. Strada's idea found firm footing on the Continent, and is noticed in Schwenter's Mathematical Recreations, published in 1660, where, after fully explaining how to make and use it, the writer says; "This is a pretty invention, but I do not believe a magnet of such power could be found in the world."

Dr Johnson, with Addison, two of the most brilliant minds of the 18th century, ridiculed the idea of intelligence being communicated by means of a magnetic needle moving over the face of a lettered dial. The idea, impossible as it then seemed, was a living germ, which [illegible] the gardener, had fallen by the wayside, until it grew and blossomed and bore fruit in the dial telegraph during the next century.

But the magnet idea was not the only one suggested as a possible means of communication. [illegible] shown that considerable electric [illegible] by means of a sulphur ball upon which, while being revolved, a second party pressed his hands [illegible] using this force for telegraphic purposes [illegible] of the philosophers. Otto Guericke [illegible] ventor of the air-pump, [illegible] chine as above [illegible] it was [illegible] that Hawksbee, an English [illegible] globe for the sulphur ball [illegible] not replace the [illegible] substituted for Hawksbee's globe

In [illegible] cut, representing this machine, [illegible] with a cross belt which [illegible] gentleman is pressing his two hands [illegible] this latter [illegible] a shallow dish, held [illegible] on a block of insulating material [illegible] she is discharging the sparks from [illegible]

[illegible]

The manipulator of the monster wheel is dressed in the [illegible] of [illegible]. The gentleman who contributes the [illegible] buckles in his shoes, an em[illegible] reaching below his thighs, and a [illegible] and lapels. A graceful white cravat swathes his neck, which is devoid of even Galway whiskers, he wears a bag wig, a ruffled shirt, and a [illegible] sword hanging gracefully at his side, completes [illegible].

The electrician to-day has an engine to do the circular work for him, his hands are not used for commutator brushes, [illegible] as a means of [illegible] defense has been supplanted by the tongue.

In 1727 Stephen Gray, a pensioner of the Charter house, [illegible] transmit signals over a wire by electricity. His line was 700 feet in length, to one end of which he attached a glass tube. By rubbing this latter a sufficient electrification of the wire was accomplished to attract light bodies to the distant end of the wire. Gray also felt that this electrical energy was the same as that seen in the heavens. Following Gray were Winkler of Leipsic, Lemonnier of Paris, Bishop Watson in London, Franklin at Philadelphia, and De Luc at Lake Geneva, Switzerland.

Watson's most remarkable experiment, of which there were many, consisted in the successful discharge of a Leyden jar through [illegible] feet of wire suspended between wooden poles.

An enterprising inventor in 1753 signed his communication C. M., told how to arrange what he denominated "An expeditious method of conveying intelligence," in these words: "Let a set of wires equal in number to the letters of the alphabet be extended horizontally between two given places; at the end of these wires let balls be suspended against a glass sheet, and the wires striking the glass, these balls would drop upon an alphabet arranged upon the table and thus by a spelling method, communication [illegible] could be made [illegible] words."

M. Lomond, according to Mr. Arthur Young, had in 1787 made a remarkable discovery in electricity. He says: "You write two or three words on a paper, he takes it with him into a room and turns a machine inclosed in a cylindrical case, at the top of which is an electrometer, a small fine pith ball; a wire connects with a similar cylinder, and electrometer in a distant apartment, and his wife by remarking the corresponding notations of the ball, writes down the words they indicate; from which it appears that he has formed an alphabet of motions. As the length of the wire makes no difference in the effect, a correspondence might be carried on at any distance. Whatever the use may be, the invention is beautiful."

It was beautiful. Simple as it now appears to us, almost childish as it would now be called, if we will consider the times and the scanty knowledge the philosophers of those days possessed of the force they were experimenting with, the results here depicted are not only beautiful, but truly remarkable.

The single wire of M. Lomond, was alternately charged and discharged from a frictional machine and the number of motions of the pith ball at the receiving end of the line in combination with the rests or spaces between letters and words, formed an alphabet, not so remarkably unlike that of Morse.

Le Sage had been endeavoring to telegraph by means of twenty-four wires, one for each letter—a method which would have crazed such accomplished wire pullers as the best mayor and council Chicago ever knew. Fortunately Mr. Lomond was enabled to shelve Mr Le Sage, and put his wires underground, but think you who have been compelled at some unfortunate era of your life to receive from a poor sender, what a ham roast would have been yours had you worked a Lomond instead of a Morse, or a Wheatstone line!

Another idea connected with frictional electricity was proposed. Reisser, Boeckman and Salva suggested and labored to utilize the sparks, successively grouped into combinations to represent letters. The apparatus of Salva of Madrid was more or less successful, but impractical, as were also the attempts in the same line of Cavallo.

[illegible] Ronalds of Hammersmith, England, erected in [illegible] eight miles in length, and labored with unremitting ardor for seven years, to solve the idea of an electrical telegraph. He used a dial containing letters and figures, and the movements of a [illegible] charge and discharge, to correspond with the desired character. This was in the second [illegible]. He offered to the government [illegible] but received for answer [illegible] are now wholly useless, and [illegible] be adopted.

[illegible] nothing daunted, [illegible] a perfect system of [illegible] he would see the [illegible] from [illegible]. He had [illegible] half a century [illegible] and magnetism [illegible] [illegible] of [illegible] from P[illegible]

Paris and attended a meeting of the Institute, at which the discoverer exhibited the battery and [illegible] explained his theory of its action. His reward was a gold medal, voted by the Academy, at the suggestion of the emperor, who also made him a present of a considerable sum of money. The following year, 1802, Volta was elected a member of the Academy, and in the same year in the family of a music dealer in Gloucester, there was born a child whose name is familiar to all of us as the inventor of the needle telegraph and the Wheatstone bridge.

The new generator of electricity described by Volta was readily constructed, and it was soon discovered that by means of a current generated by the pile water might be resolved into the two gases, hydrogen and oxygen.

Taking this as a lead, Sömmering, in 1808, devised a method of telegraphing by generating bubbles in water. Thirty five glass tubes, closed at one end, were filled with water, and inverted over a similar number of gilded strips, immersed also in a glass trough. Each tube was the representative of a letter or a numeral, and was connected through the water to the proper wire coming from the sending station. Now, when the two poles of the pile at the sending station were brought in contact with two terminals, bubbles would be displayed at the receiving end. Thus two letters might be sent at once, the hydrogen bubbles taking precedence over the oxygen. The amount of gas disengaged from the water being greater at the hydrogen pole, this was easily distinguished from the other. When only one letter or figure was to be sent, the connection was made over one wire only.

The inventor proposed the use of gas thus liberated to the discharge of some species of alarm at the receiving station, as an office call. While Europe was laboring in this direction, Dr T. R Coxe of Philadelphia was calling the attention of scientists and practical workers on this side of the ocean to an almost identical method of communication, and he also suggested the use of electrical energy for decomposing metallic salts in solution.

This was subsequently pretty thoroughly worked up by Bain, in his electro-chemical telegraph, which was used on the O'Reilly lines in opposition to the Morse lines in the early days. In the Bain process every office had its own main battery, and this was grounded at the negative end. When an intermediate office desired to call another, the operator first switched off all the line in the opposite direction. When the called office was ready to answer—generally during the same day—he cut off the rest of the line, so that the wire for the time being was often divided into three sections of greater or less dimensions—one from the terminal to one of the stations engaged, one from this to the second engaged party, and one from this party to the other terminal. The sending party, by closing his key, sent current to line from the positive pole. At the receiving station the current went direct to an iron wire pen resting upon a disk covered with many sheets of wet chemical paper, which revolved horizontally. A guide at the inner end of the pen lever, resting in a helical or worm track, worked the pen outward, so that the line of reading was in a spiral form. From this the current went to ground.

The solution was made of a salt of potash and nitric acid with water, and the paper was a dark green. The electrical action decomposed the iron point and left a deposit of Prussian blue (iron prusiate) upon the paper.

It was my fortune to play the part of operator and manager on one of Bain's lines. The handling of the paper was a filthy job, and after some experimenting I finally succeeded in getting a yellow and afterward a white paper, very much to the astonishment of Mr. Bain, who came to America to be astonished by a native, hardly old enough to vote. I mention the fact, not through egotism, but simply to show how an inventor will often overlook some simple matter of detail, which may be of much more importance than some intricate will o'-the wisp he is following.

The discovery of Oersted of Copenhagen, in 1820, that magnetism could be made manifest in an iron bar properly surrounded by a wire through which a current of electricity was circulated set the savants again at work with new devices. Here was a power capable of showing an effect at a distance, which had more positiveness in its action than anything heretofore used. Frictional electricity had been discarded by all experimenters, the use of many wires had proven too cumbersome, too expensive and too delicate. In this last great discovery there was the germ, and it only needed the proper method of cultivation to bring it to maturity, to make the mysterious power transform itself, and do mechanical labor at the bidding of man.

Ampere, the French philosopher and scientist, whose name will probably be known to every electrical worker of the future, until long after its owner has been forgotten, grasped the problem, and before the French academy explained the action of a current surrounding a magnetic needle placed in the magnetic meridian.

Others followed in the wake of Ampere, and the galvanometer became, in its simple form, a fixed fact, known to all electrical philosophers, yet it progressed no farther than the laboratory until 1832, when Baron Schilling, of Cronstadt, exhibited a [illegible] needle telegraph. He died without having a [illegible] perfect working exemplification of his system, [illegible] methods, which included [illegible] needle system, [illegible] in the following year by [illegible] Weber, of Göttingen, by leading two wires from the [illegible], a distance of nearly two miles, to the [illegible]. The signals were made by small deflections of a magnet suspended horizontally within a coil [illegible] mirror.

[illegible] Steinheil, of Munich, [illegible] current [illegible] of telegraphy [illegible], and other workers in [illegible] [illegible] the fact that the ground [illegible] [illegible] in which [illegible] combination, produced a

very complete, and at the same time simple code of letters. In one of his systems two needles were made to deflect, one by a positive the other by a negative current, but always in the same direction. These needles in another form of instruments were made to strike upon bells, and sometimes to produce dots, by means of capillary tubes charged with ink, thus leaving a permanent record on a strip of paper tape. Prof. Morse averred that he made the discovery which has rendered his name famous for all time, in 1832, while on board the brig Sully, homeward bound, in mid ocean.

The juvenile days of the telegraph were now nearly over. The experimenters, who had labored earnestly, who had borne patiently the taunts and sneers of the world, had been called fools and knaves and cranks, for an hundred years, in their endeavor to discover some feasible method of transmitting thought by electricity, were now on the eve of success. Obloquy and disappointment had been their reward, their encouragement, which, as a legacy, they had left to their successors.

Scientific investigation means revolution, and revolutions never go backward. Success ultimately crowns properly directed effort, and the world had now arrived at a period when telegraphy became a practical art. Three systems, each differing from the other in many respects, were very shortly established in as many widely separated countries. Steinheil's at Munich, Wheatstone and Cook's in England, and Morse's in America.

Yet neither one of these three systems can be called a pure invention—each was rather a growth, an adaptation of discoveries made by others. Everything previous to Oersted's discovery of the electro magnet, while unavailable in practice, had tended to spur on the one idea of electrical communication, and when the fact was promulgated Ampere, by a natural application of the discovery, invented the galvanometer. From this, as a starting point, Schilling, Gauss and Weber, and Steinheil, using the induction set up in a permanent magnet, by raising and lowering a coil surrounding it as a transmitter, while the deflections of a suspended needle with a reflector served as a receiver, were but a step in the rear of Thomson, and the reflecting galvanometer.

Steinheil's transmitter consisted of seventeen horse-shoe magnets, weighing about two and one-half pounds each, or a total of sixty pounds, and the two induction coils, with their 15,000 turns of silk insulated copper wire, revolved upon an axis in such a way as to alternately present these before the poles of the magnet, and thus generate an induced current, which, if the crank was turned in one direction, sent electricity of one polarity to the line, while a reversal of the motion reversed the current. Two tubular needles, charged with ink, at the receiving end of the line, were actuated by these two currents, and two lines of signals, one above the other, were recorded on the moving tape. As neither needle was actuated by the current which moved the other, because of the polarity of the magnet to which it was attached, combinations of dots readily made up an alphabet.

Cook & Wheatstone's first patent was taken out in their joint names in 1837. This telegraph system had five wires and five needles. The principle of action is found in the fact that a current of electricity passing along a wire will deflect a magnet or magnetic needle.

Imagine a diamond-shaped frame, crossed by lines parallel to its edges, and at the points where these lines cross the various letters of the alphabet. Along the transverse diameter of the diamond are five magnetic needles, each pertaining to a wire of its own, and a sixth wire answering for a general return wire of the metallic circuit. Now, suppose a negative current be sent into one of these lines, and a positive into another, the needles will be deflected in opposite directions. A line drawn through these will always terminate at a letter, and that letter is the one intended. Six wires for one message! To-day more than that number of messages to a wire, and more than one hundred times the distance in the bargain!

Wheatstone's first line was laid on the Northwestern railway in July, 1837, and was one and one-half miles long.

The inventor, with high-beating pulse, yet cheerful with hope, and a firm confidence in success, was stationed in a dingy room in Euston square, where the only light was that shed by a single candle. At the far away station of Camden Town, less than the distance from State street to Western avenue, sat Cook, Mr Fox and Mr. Stevenson, amid as gloomy surroundings as the inventor. The first words were read by the three gentlemen, and replied to by Mr Cook. The telegraph was pronounced a success by all present, and the trio were jubilant. Yet the public treated the invention with indifference, and the directors of the railroad company ordered it away. One of these officials denounced the telegraph as a new fangled thing. This system, subsequently modified and improved, became a two needle system, and afterward a one needle system, and long held its own as the telegraph system of Great Britain.

In America Morse had no better success in escaping the fate of all that class of cranks to which the general people had consigned him, nor from the piratical claims of those who would wrest the prize from his grasp so soon as his untiring labors and victory over the multifarious annoyances had proven it prospectively valuable.

Public opinion had applied to him the joint epithet of knave and fool, as well as crank. Five years elapsed after his first invention on the Sully, during which time frequent attempts were made to rob him of his invention. The first caveat was filed in 1837, and six months afterward a patent was applied for, which he obtained in 1840—eight years after his first conception. One fourth of the patent was finally assigned to Mr. Alfred Vail, to enable the inventor to bring the new born infant properly before the public.

The first really good instrument was made at the Vail factory, Morristown, N. J., in 1838, and worked a line of wire three miles in length, installed in a room in the factory. A few days afterward it was exhibited in New York. Its fame had now reached the Franklin Institute,

of Philadelphia, and its committee on sciences and arts inspected it. A full and very interesting report was made to the institute. From that report I make the following extracts, descriptive of the apparatus:

"Near the battery, at one of the stations, there is an interruption in the circuit, the ends of the separated wire entering into two cups near to each other containing mercury. Now if a small piece of bent wire be introduced, with an end in each cup, the circuit will be completed, the electro-magnet at the other station will be set in action, the keeper will be drawn against it, and the pen will make a mark upon the revolving paper," etc. Again

"The successive connections and interruptions of the circuit are executed by means of an ingenious contrivance for depressing the arch of copper wire into the cups of mercury, and raising it out of them." The use of a second electro-magnet to give warning by the ringing of a bell, and to set the apparatus in motion, when a call is made, was one among other distinctive features which the committee mentioned.

The apparatus was exhibited to members of congress, to scientific and practical men, to the heads of the departments of the national government, and to the president. The house committee on commerce recommended an appropriation of $30,000 to test the working of the system.

But before this time, 1838, the London *Mechanics' Magazine* and *Silliman's Journal* had published full descriptions of the invention, and the attorney-general of England decided that no patent should issue there. In France, while a patent was granted it was necessary that the telegraph should be put in operation within two years, which was found to be impossible.

The session of 1841, as well as that of 1842, passed without relief to the poor inventor. Finally, in 1843, Representative Kennedy of Maryland, moved that the committee recommend the passage of the bill authorizing the paymaster general to expend $30 000 in testing the merits of Morse's electro-magnetic telegraph. One member moved that half the amount be devoted to the investigation of mesmerism, and a second wanted millerism investigated, while a still more disparaging suggestion was made that a portion of the money be appropriated for telegraphing to the moon. Congress, despite these various attempts to descry the invention, passed the bill by a vote of 89 to 83, and the American system of telegraphy was a breathing entity, with a patronizing government for its godfather.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 15.—At a meeting of the Gas Commission, the bids of six electric light companies for lighting the streets were rejected, as the commissioners thought the increase in all the bids showed a tendency toward a combine among the several electric illuminating companies. The commissioners will readvertise for bids under amended specifications made necessary by the taking down of poles and wires since the last bids were received. It is claimed that the alleged combine has been strengthened by the Board of Electrical Control in its unwillingness to grant any permits for poles and wires, and in order to make competition keen between the several companies it will be necessary to let the new companies put up poles and wires for the present in streets where they are needed.

The complaint of the Board of Electrical Control against the electric light companies has been dismissed by the present grand jury. Mayor Grant expressed his dissatisfaction and asked District Attorney Fellows to have prepared for him a record of the facts in the case as presented to the grand jury.

At the annual meeting of the stockholders of the Erie Telegraph & Telephone company, the following directors were re-elected: Levi Sprague, Charles A Glidden, Charles E. Adams, Francis Jewett, A. C. Russell J. W. C. Pickering and Abner S. Adams of Lowell, Mass.; Wesley A. Gove of East Boston; James A. Weston of Manchester, N. H.; H. A. Whiting of Wilton, N. H.; and W. J. McKinnie of Cleveland, O.

A syndicate represented by I. B. Newcomb has purchased the electric railway now running from Brooklyn to Jamaica. This railway in connection with the Kings County Elevated railway will provide rapid transit from Fulton Ferry to Jamaica, and will undoubtedly advance the price of land in the vicinity of the latter place.

The factory of the Callender Insulating & Waterproofing company at Harrison, N. J., was struck by lightning and burned to the ground Tuesday afternoon. All the machinery and material in the factory was totally destroyed, and the loss at the lowest estimate is $60,000. Since the failure of the company and the appointment of a receiver about the only hopes for the creditors to realize anything was centered in the factory, and now that is destroyed with all its contents, it appears the last ground for hope has failed.

Electric lights are going into several of the prominent theaters, and the lighting of Palmer's theater and the Bijou will very soon be effected. This will be a greater inducement for the public to indulge in amusements during the hot weather, and an additional attendance will surely be had, as the greatest complaint against theaters in summer is the intense heat caused by the gas light.

The New York Central Railroad company has clo[illegible] contract with the Edison company to put [illegible] light plant at the Grand Central station. It will need 1,400 incandescent lamps to supply all the [illegible] passenger rooms and the long train building with light. The electric lights will not be used in the yards, as they will interfere with the signaling of other lights by their extreme brilliancy. After passing the yards the long tunnel will be strung with incandescent lights, and the much-needed improvement in the tunnel will be effected.

The West End Railroad of Boston has declared a dividend of 5 per cent. semi-annually on its common stock, to be paid July 1st. The directors of the American Bell Telephone company in Boston also declare a dividend of $3 a share as the regular quarterly dividend, and $6 a share as an extra dividend. Both are payable July 16th.

Ex-Congressman W. Bourke Cockran, who will conduct the appeal of Kemmler, sentenced to death by the application of electricity, said recently "I believe the law to be unconstitutional and inhuman, and deem it due to the honor of the state and for the welfare of justice that it should be tested. No electrical company has retained me, and I am doing this without hope of financial remuneration." He also said "I wish you would say that I am not retained by the Westinghouse Electric company on behalf of Kemmler."

Mrs. Amelia Streiffer has just secured a verdict of $2 000 against the United States Illuminating company. Her son was killed by a current from the company's wires in this city some time ago.

James W Appleby, who died in an Atlanta, Ga., hospital on the 10th inst., was a promising young man. His remains were returned to this city for burial. He was representing A. L. Bogart, who had the contract for wiring the State capitol at Atlanta when he was taken ill.

The revelations during the trial of William E Howard, who is charged with fraudulent practices in connection with the alleged electric refining sugar swindle, caused a sensation in New York, Tuesday. District Attorney Fellows presented witnesses who testified that Howard purchased refined sugar in large quantities—100 barrels at a time—under an assumed name, had the heads of the barrels painted white, so as to remove all marks of identification, and then had it carted to the electric refining works of Prof. Friend, where it was dropped through chutes to the mystification of the venerable Lawson N. Fuller, and other victims. The persons from whom the sugar was purchased, the cartmen who removed it, the men who received it at the "works," and assisted in the detection of the stockholders, assembled to witness the demonstration—all of these important witnesses testified as to their connection with or knowledge of the facts in the alleged conspiracy. Two of the employes of the Friends gave damaging evidence. No cross examination was attempted, and it was evident the testimony of the former employes of the Friends filled Howard and his associates with consternation. In his own behalf Howard testified that he met Friend in Chicago in 1883, and later in New York renewed his acquaintance. It was then he became interested in the sugar refining machines. W H T.

Kansas City, Mo.

KANSAS CITY, June 15.—A reorganization of the Blue Valley Street Railway company and the St John Street Cable company will be made in a few days, under the name of the East Side Electrical Street Railway company. The papers for the incorporation of the new company are prepared, and will be filed as soon as a few preliminaries have been arranged. It is the intention of the company to purchase from the Metropolitan Street Railway company the Independence avenue horse car line, and to construct an electrical street railway, the route of which will be on Fifth street from Walnut to Grand avenue, to Independence avenue, to Highland avenue, to Lexington avenue, to Agnes avenue, to St. John avenue and out St. John avenue half a mile east of the city limits. The Metropolitan company has already signified its willingness to sell the Independence avenue line, and as soon as the new company is organized, the purchase will be made. Capital is at hand, and Mr Knight the engineer who will have charge of the construction, says that work upon the new line will begin within two weeks. Mr. Knight, during his recent eastern trip, made an examination of the various electrical railways now in operation, and it was upon his report that it was decided to make the road an electrical instead of a cable line. The road will be operated by overhead wire, and will be of similar construction to the one now in operation at Topeka, which has given satisfaction. The franchise for a road from the terminus of the Independence avenue line over the proposed route is already in the hands of the Blue Valley company, and will be turned over to the new organization.

The telephone company has adopted a new rate of $60 [illegible] charging $48 for some telephones, and $72 for others, and [illegible] The subscriber protested and [illegible] instrument [illegible] and he had to move the instrument [illegible] rate. It was from this that the trouble [illegible] would be paying $48 per year for his telephone service, and another in the next street, or possibly in the next house, had to pay $72, and the latter subscriber was inclined to object. A physician found that he was paying more for his service than some of his brother doctors, and made a stir. You know that a petition was sent to the legislature, and that a bill was drawn reducing the rates. I invited the Commercial club to investigate [illegible] and the committee favored an equalization. We waited until the legislature adjourned before commencing the alteration, believing it possible that the legislature might regulate rates. Many subscribers have opposed the change. My idea is that the plan pursued in St. Louis is the best for the company. There the charge is $100 per annum, whether the instrument is across the street from the exchange, or seven miles distant. No distinction is made between residences and business houses, and distance does not enter into the consideration. There are not so many telephones in use in St. Louis as there are here, by more than 200. When the gentlemen appointed by the Commercial club completed their investigation and reported their findings to the club, a delegation was sent to Jefferson City to lobby against the bill. The club may decide to take up the question again."

Among those who will pay the additional rate are members of the club. The dissatisfied telephone subscribers may bring the case to the attention of the council, and begin a systematic agitation against present telephone prices. The new charter gives the council the authority to regulate telephone rates, and it will be under this provision that the objectors will seek to strike a blow at the telephone company. The telephone company claims that the charter provision is unconstitutional, and that the legislature alone has authority to regulate charges.

The Vine Street Motor Railway company has let the contract for doing the work of changing the road from a steam dummy line to an electric motor power line. The Western Electrical Construction company will do the work, and the Thomson-Houston Electrical company will furnish the electrical equipments. The cost will be about $[illegible],000. The work will be completed in six weeks. The present line extends from Eighteenth street south on Vine street to the city limits, and six trains will be run. Should the outlook be favorable, the line will be extended south beyond the city limits about a mile.

There will be a meeting of the stockholders of the Kansas City Electric Light company on Thursday, [illegible], for the purpose of voting upon the proposition of issuing bonds to the amount of $150,000, payable in twenty years, and bearing interest at 6 per cent.

The County court has granted a franchise to the Kansas City Suburban Railroad company to construct an electric street railroad on Troost avenue, from the end of the Troost avenue cable line to a point [illegible] miles south. Work must begin within sixty days, and the road [illegible] next spring. The company has made arrangements for introducing a first class electric system. President [illegible] is interested in the Kansas City Cable company [illegible] largely interested in the new company, and desires to give the electric system a thorough test. Residents of the section through which the new road will pass are [illegible] interested in the improvement. A number of property owners south of the present proposed [illegible] the road extended a matter of a mile farther [illegible] doubt raise a bonus to induce the company [illegible]. The length of the road will be [illegible] the crossing of the Waldo Park [illegible]. Many Kansas City residents have promised to [illegible] route where they can get large tracts of [illegible]

[illegible] track the entire length. The poles will be of iron, having an electric light at the [illegible] be used than on [illegible] in Kansas City, and cars will be run at a rate of about ten miles an hour.

The Consolidated Electric Light company of Kansas City, Kan., has filed suit against the Metropolitan Street Railway company to restrain the latter company from erecting wires along Osage avenue for its proposed electric system. [illegible] claims that the manner [illegible] are being erected will interfere with its rights in lighting the streets. It is also claimed that the wires can be erected at an additional cost of $1,000, so that there will be no interference whatever. P.

Indianapolis, Ind.

INDIANAPOLIS, June 15.—The aldermanic committee on light made its report Monday night. It shows that on March 1 the city was using and paying for 2,658 gas lamps at $15 per annum; 246 vapor lights at $18 per annum; 100 arc lights at $60 per annum, making a total of [illegible]. Since that date 310 gas lamps have been discontinued on streets where electric lamps are located. The committee recommend cutting off, in addition, 216 gas and 125 vapor lights, which will leave the annual cost for lighting $40,285. The contract with the Brush Electric Light company gives the city the right to call for additional electric lamps at the rate of $81 per annum. There is considerable call for more light in outside parts of the city, for which the committee recommends electric light.

The Train Dispatchers' association of America met here, this week, at Y. M. C. A. hall, the meeting continuing three days. There were 125 delegates present, representing all the States, Territories, Canada and Mexico. This is the second meeting, the association having been reorganized at Louisville, Ky., one year ago. The officers are: A. A Zion of Indianapolis, president; W. H. Coppage of Chattanooga, Tenn., vice-president; E J. Peabody of Chicago, secretary and treasurer; the executive committee, W. H. Graves, Winona, Minn.; C. L. Pasho, Bradford, Pa , W. W Polk, Water Valley, Miss ; H. H. Libbe, St Joseph, Mo., all of whom were present. The convention was welcomed to the city by Mayor Denny. President Zion in his address gave the history of the association, showing that the organization started with 97 members. There are now 654 members in good standing. Mr. Zion closed by recommending several changes in the constitution which had been found advisable. The treasurer's report shows receipts have fallen a little below expenses, but this will be overcome during the present year. He urged upon the members the advantages of the mutual benefit branch of the association. Several amendments were made to the constitution.

It was proposed to reduce the salary of the secretary from [illegible] $24 per month, but to this there was considerable objection, and $49 was agreed upon as a compromise. The executive committee found the affairs of the mutual [illegible] association in a good condition and well managed.

The [illegible] session was opened by an address from Rev. [illegible] of this city.

[illegible] upon a place for next meeting [illegible] President Zion appointed following committees:

[illegible]—[illegible] A. Smith, Boston; J. [illegible] H. [illegible] Ithaca, N. Y.; C. A. [illegible] East Saginaw, [illegible] Woolsey, Terre [illegible] W. R. Mailler, [illegible] Ottawa, Ont.; J. [illegible] H. O. Pond, Co- [illegible] Keith Lackey, [illegible] O. E. [illegible] of train by [illegible] Mo.; J. H. [illegible] A. W. [illegible]

[illegible]

Polk, Water Valley, Miss ; G. B. Fairbanks, Tulare, Cal.; John Reilly, Smith Falls, Ont After an excursion around the Belt railway the delegates left for their homes. But one member of the association has died during the past year. The convention took up a collection for destitute miners at Brazil, Ind.

The Central Union Telephone company have asked the commissioners of this county for the privilege of erecting poles along the highways with a view to extending its service to the smaller towns. M.

St. Louis, Mo.

ST. LOUIS, June 14.—General Manager David J. Harris of the St. Louis Universal Electrical Exhibition, has sent to exhibitors a statement of the general plans for the exhibition, to be opened September 4, and to continue for six weeks. It has been decided that no charges shall be made for power or space when occupied by exhibitors whose applications shall have been received and accepted before July 15th. Applications for sixty-five different exhibits are already on file For electrical exhibits 75,000 square feet have been reserved. Gilmore's band has been engaged to furnish music for the entire six weeks. The music in the large hall will be reproduced by an Edison phonograph in the smaller hall. It is proposed to surpass all electrical exhibitions held in this country since 1876.

The Missouri Electric company has engaged space for an attractive exhibition of the Westinghouse alternating system.

It is intended to have, among other attractions, a typesetting machine operated by electricity, as well as machinery of all other kinds.

Christian Peper, president of the St. Louis Railroad company, said, in speaking of the electric motor experiments on the south end of the Broadway line: "The experiments have proved to my satisfaction that the system is in itself an excellent one. Certain mechanical difficulties now experienced can easily be overcome. The directors will hold a meeting Thursday or Friday of next week to review the experiments, and consider what they will do in the matter. I cannot say now whether the company will go ahead and adopt the system for all the lines for which it has electric franchises or not. The directors may take some action in the matter." The St. Louis company has franchises to operate its lines north of Cass avenue and south of Elm street by the overhead wire system.

The recent burning out of the telephone wires in this city was the severest blow dealt the Bell Telephone company at one time for years. An attempt was made in the headquarters to keep a record of the complaints as they poured in through uninjured telephones, by messenger boys and mail, until the operator who keeps tally was compelled to enter on his daily report, "June 8th—complaints too numerous to mention. Terrific electrical storm raging." Such a day has never been experienced since the telephone was put into service in this city. As soon as the service became crippled the regular corps of linemen, fifteen in all, were sent out to every part of the city to repair the damage. Linemen were called into service from the Western Union and other companies until forty men were repairing Bell telephone wires. In the evening it was estimated that over three hundred telephones were affected by the electrical disturbances and electric light wires. Everything is in order at present, however. P.

ST. LOUIS, June 17.—D. J. Harris has resigned his position as manager of the Electrical Exposition, and will be succeeded by Fred H. Whipple of Detroit.

The Lindell Street Railroad company has placed an order with the Sprague Electric Railway company for ten double motor cars, fully equipped. The overhead system will be used. This road is double tracked, and will run as an extension to Forest Park of the Chouteau Avenue line, owned by the same company. The entire distance operated by electricity will be about four miles. The company will run this road through the fall and winter, and if the experiment proves successful it will equip its entire line with electricity [illegible] miles of track.

The Brownell Wright Car company of this city has just completed an order for ten cars for the electric road at Tiffin, O.

The Missouri Electric Light & Power company has [illegible] 250 horse power Buckeye engine, together with a [illegible] of boilers, of the Exposition directors until August [illegible] the station will be completed. [illegible] light dynamo, which [illegible] where it is absolutely [illegible] power Westinghouse [illegible] place in position soon [illegible] with about 1,000 [illegible] B.

Cleveland, Ohio.

CLEVELAND, June 15.—An electric railway connecting the South Side, Brooklyn and down town will be one of the new enterprises of this season. Storage batteries will be used if practicable or if not the overhead system will be put in. For some time preliminary arrangements have been progressing. Tom L. Johnson asked leave of the Board of Improvements to extend his narrow gauge line on Scranton avenue straight up to Vega avenue. At that time several prominent residents of Scranton avenue and owners of real estate on the South side thought that this request was only to "plug up" Scranton avenue to prevent the building of an opposition road to the South side. A road with Vega avenue as the terminus and running up two steep hills and over one bridge, would be no earthly use to any one, they argued. There was much dissatisfaction about the route of the present South side line at the time, though it is doing a good business, and several prominent South siders got together and discussed the advisability of trying to get through to the city They decided that the best and shortest route to the city would be from the junction of Pearl street and Scranton avenue at Riverside cemetery, through Scranton to Willey street, Willey to Jennings, Jennings to the Central viaduct and from there over the route followed by the present South side line to Public square The consent of property owners along the proposed route was secured, a company was immediately formed with $200 000 capital, and a charter secured, the incorporators being: J. S. Hartzell, J. M. Curtiss, Alfred Kellogg, Frank E. Bliss, D. E. McLean, H. M. Farnsworth, A. B. Williams and C. B Humiston. As soon as the proprietors of the enterprise decide upon the system to be adopted, the work will be pushed to a speedy conclusion O. B.

San Francisco, Cal.

SAN FRANCISCO, Cal., June 10.—Chico, Cal., is advertising for bids for lighting the city by electricity. It is only a short while since the Westinghouse company installed a plant there, and it is presumed that the local company will capture the contract. The California Electric Light company has started up its new station and is now running five No. 8 dynamos and will shortly move the remainder from the old station on Stevenson street, using that building entirely for incandescent purposes.

The *Chronicle* of this week referred in an editorial to the transmission of power by electricity as accomplished by the Willamette Falls Electric company of Portland, Ore. and stated that it was expected the power of the American River would be transmitted to this city before long The experimental station of the Wave Power company at the Cliff House was forgotten apparently. President Steinman and Superintendent Pierson, of the Sacramento Electric Light company, have just returned from a tour through the East and have concluded to adopt the Brush system of alternating incandescent lighting. W. G. C.

THE ELECTRIC LIGHT.

Electric light plants are being introduced extensively in cotton mills in Mississippi. The Tombigbee company will light its extensive works at Columbus with incandescent lights.

The Baton Rouge Electric Light & Power company and the Baton Rouge Gas company, after a short consolidation, have separated, and the former company will add to its electric light plant machinery for incandescent lighting.

John N. Cleary, an employe of the Municipal Electric Lighting company, of New York, who was last February disabled by an electric shock has been granted $6,757 by the Brooklyn Supreme court, in which he sued the company for $50,000 damages.

H. O. Woodruff of Des Moines, Iowa, reports the sale of a 600 light "Hawkeye" dynamo to W. Rathvon, Denver, Colo., one 120 light dynamo to the Mollie Gibson Mill and Mine, Aspen, Colo., and one 75 light machine to the Des Moines Water Works company.

The plans of the city engineer of Oakland, Cal., provides for the erection of 338 electric lights for illuminating the streets. It is proposed to divide the lights into 130 single lamps and 52 towers, each of the latter containing four lamps. Poles for single lamps will be 50 feet high while the towers will be 100 feet high.

Kankakee will have a new electric light plant consisting of a 750 light Westinghouse machine, two 45 light arc dynamos for commercial lighting, and one dynamo, same style, for street lighting. The machinery for the plant will all be new, boilers, engines and dynamos, and is now being made in Buffalo, N. Y., and will be ready when the building is The cost of the new plant will be about $35,000.

The Commercial Electric company of Detroit, Mich., has closed a contract for a complete electrical and steam plant for the new theater and Wonderland now being built at Buffalo, N. Y. The plant will consist of two Mayo incandescent dynamos of 200 light capacity each, and 40-horse power high speed automatic Taylor engine, and boiler of

the same make. The engine and dynamos are to be located on the second floor of the building in Exhibition Hall.

A dispatch from Milwaukee says: The work of fitting the steamer Manhattan of the Inter Ocean Transportation Line with one of the most complete electric light plants on the lakes has just been finished. There is not a particle of space in the large vessel, from stem to stern, that cannot instantly be made as light as day, and she is also provided with signal lights, submarine lights, and a 500 candle power search light. The latter is supplemented with powerful reflectors, and can produce a glare that will pierce the thickest fog for a considerable distance. It will be exceedingly useful on many occasions, particularly when the vessel is entering a difficult harbor or finding her way to her dock on a muggy night.

One of the most recent of the isolated plants installed by the United States company is that started a few weeks ago in the basement of the McIntosh flats, corner Forty-third street and Bowen avenue, Chicago The dynamo is of 125 light capacity and wound for 110 volts. A Payne automatic 15-horse power engine furnishes power for the machine and takes steam from boilers located underneath the pavement. These boilers also supply the steam elevators and heating apparatus. Three groups of 10 lights each are hung outside the building, one over the main entrance on Forty-third street, another on the corner and the third on Bowen avenue. The remainder of the lights are distributed through the halls and passages of the "flats." The effect of the three outside groups is quite striking.

A severe test of the insulation of the House-to-House company's mains was made in an accident at West Brompton, England, recently. The West Middlesex Water Works company's main pipe, five inches in diameter, in which the water is at a pressure of 125 pounds, burst in Barkstone gardens. The quantity of water that escaped was so great that it inundated the road, and caused the ground to sink considerably. The water pipe was laid three feet, six inches below the road level, and the House-to-House company's electric light mains were about two feet, six inches above this pipe. One of their road boxes was exactly over the spot where the pipe burst, and as a large quantity of soil was washed away, this box was lowered some eighteen inches. The pipes followed the box, yielding only at the cork joints, and without a single breakage of the wires, they filled with water, which traveled along and trickled into the basements of one of the houses the company is lighting; but, nevertheless, the cable continued to run the lights satisfactorily. This may be considered as a very severe test for any underground system of electric lighting to withstand. Indeed, the gas fared worse than electric light, for a lamp post ten yards distant fell down with a crash under the exceptional sinking of the road. Twelve cartloads of gravel had to be put on in order to bring the road to its proper level. The electric mains were raised to their proper position, without the slightest interruption to the working, within twenty-four hours of hearing of the accident that had occurred. The copper mains of the House-to-House company's system are very highly insulated, and this fact stood them in good stead. Such an accident is, of course, exceptional.

An interesting patent suit is in progress in Berlin, Germany. About eight years ago the German Edison company instituted an action for infringement of patent rights against the Swan company, and later also against the Khotinsky company. This suit was taken over by their successors, the Allegemeine Elektricitatsgesellschaft. Although the Edison patents have been curtailed in some of their claims during the suit, the result was, on the whole, favorable to the company, but has not yet been confirmed by the Leipsic tribunal, which is the highest court for patent cases. This long and intricate lawsuit has recently been still further complicated by the addition of an action against the Seel company, and by a combination of the Allegemeine Elektricitatsgesellschaft and Siemens & Halske, who are joint plaintiffs in this action. The latter firm had, in 1887, when the Seel patents were applied for, lodged an opposition to them, but ineffectually. It has now been found that the Seel company does not manufacture exactly in accordance with its own patents, and on the basis of this discovery the two firms above mentioned have brought an action against the Seel company, fixing the damages at £15,000. Great interest is felt in electrical circles in the forthcoming trial, which will begin on July 2d. The suit in Germany will be fought upon somewhat different lines from those which guided the English suit, the reason mainly being that there is no German patent for flashing lamps, whereas in the English suit this patent was one of the strongest points of the Edison company. As regards financial resources, the opponents are unequal, since the combined firms represent jointly a capital of £2,500,000, whereas the Seel company only represents about £50,000.

THE TELEPHONE.

The Bell Telephone directors met at Boston last week and declared a 3 per cent. quarterly dividend and a "regular extra" 6 per cent. dividend, both payable July 15th to stock of June 29th. They also commended the issue of $2,500,000 new stock, one-half in October and one-half in April, and called a special meeting of shareholders for September 12th to accept the act of authorizing the same. This is a somewhat smaller amount than it was expected would be issued.

A correspondent, writing to an English paper from East Kent, says: It has been discovered that a large number of messages are sent over the wires fraudulently. Persons, too penurious to have instruments of their own, are in the habit of going to their neighbors or customers, who, ignorant of the risk they run of an action, allow their telephones to [illegible]," adds the district manager, "[illegible] operators are quickly learning to distinguish the [illegible] these pirates [illegible] exchange [illegible] the result that they are immediately disconnected."

THE ELECTRIC MOTOR.

Leonard & [illegible] of Chicago, have just secured the contract for construction for the Sprague electric road at Pittsburgh, Pa. Their contract is for $[illegible].

The Thomson-Houston company of Boston reports the sale of 20 motors ranging from 1 to 10 horse power. The uses to which these motors are put are multiplying.

The Helena Steam Power & Lighting company of Helena, D. T., has decided to increase its capital stock from $50,000 to $200,000. The company is also considering the advisability of installing a number of electric motors for running elevators, printing presses, etc.

The Des Moines electric road is indirectly affected by the Pennsylvania flood. The improved curves that this road is putting in were manufactured by the iron works destroyed in the Johnstown catastrophe. The company had a number of unfilled orders, and these will have to be placed elsewhere.

The Sprague company announces that since the opening of its electric road at Atlantic City, 6,464 trips have been made, and adds: "During this time, and in spite of the fact that the motors used upon this road were of the new Sprague type, which had hitherto not been tried upon any road, not a single trip was lost by the electric cars."

A citizen of a neighboring county came to town yesterday and was seen standing on Broad street studying the electric cars. He looked at them for awhile thoughtfully and didn't seem very enthusiastic. He appeared to be in a sort of reverie. At last I stepped up to him and asked: "Well, what do think of it?" My new friend looked at me for a minute and replied slowly: "I was just thinking how the Yankees came down here and freed our niggers. Now the same blamed fellows have come down and freed our mules."—*Nashville American.*

The Hawkeye Electric Manufacturing company have recently sold through their representative, H. O. Woodruff of Des Moines, a 6 horse power motor to George A. Miller of that city, and the following in Denver, Colo.: Denver Lithograph company, 15 horse power; W. J. Kinsey Implement company elevator, 8 horse power; Zalinger Printing company, 5 horse power; Novelty Manufacturing company, 4 horse power; Von Shultz & Son, 3 horse power; W. H. Kistler & company, 3 horse power; Wm. L Patten & company, 2 horse power; John App, 1 horse power.

At Cincinnati, the new line of electric cars, recently installed by the Daft company, runs for a short distance over the Gilbert avenue cable line. Just in front of the power house, the cable, which is in two divisions, ends; and for a short distance, the trains of two cars passing this point have to release their grip from one cable and travel by momentum alone until they take hold upon the other. As it frequently happens that the momentum of the train is not sufficient to carry it across, a winding drum with a cable attached, has been placed at the point of division and is used to bridge the gap. Recently, a car was sent out with a new grip, which was a little too large, and upon arriving at the point referred to, the grip jammed in the slot. The winding cable was attached and the drum started, but the car did not move. While preparing for another trial, one of the electric cars came along, and with no very apparent effort pushed the cable car in front of it until it could take hold of the cable. This was done on a slippery track, and is a very clear demonstration of the ease with which the electric motor encounters difficulties and the large reserve force, so useful in emergencies, which it possesses.

A delegation from Detroit, Mich., consisting of Frank Higgins, Joseph H. Clixby, Frederick C Blatches, Alexander E Riopelle, Conrad Clippert, Louis Smith, Christ Reamer, Wm. Ford and L. D. Haggerty, visited Cleveland last week for the purpose of inspecting the electric railways in operation there The *Free Press* says of the movement for electric cars: "The Detroit City Railway company has been repeatedly appealed to to use electricity as a motive power for its cars. Accordingly as the new Mack road line, which branches from the Gratiot avenue line, near Mt Elliot avenue, was nearly ready to run cars, it was determined to try electricity. Erection of poles to carry the wires was commenced, but opposition was met with from a number of citizens along the line who did not wish to have the street encumbered. Acting under advice of City Counselor McGrath a posse of property owners attacked the poles with axes Monday night and one of the party, Lewis Fitzwalls, was arrested and locked up. He was yesterday discharged by Justice Miner, who thought that the legal proposition involved was of too large a caliber for his court. The City Railway company says that it intends to experiment with electric cars on the Mack road, and if it is found to work successfully a thoroughly equipped electric line will be made of it."

A trial test of the newly improved Sims Edison electric torpedo was made at Willet's Point, on Long Island Sound, last week. This torpedo is similar in construction to the Sims Edison torpedo adopted by the government some years ago. It is thirty-one feet long and twenty-four inches in diameter. It weighs 3,000 pounds. It has a cylindrical hull with conical ends made in four sections united by means of lock joints. The hull, which is submerged, is supported by an indestructible float, which is attached to the hull by upright stanchions. The electric current is carried through a small insulated cable, and its force is directed from the shore. A new 1,200-volt Edison municipal dynamo, put in by the government at Willet's Point, furnished the power. G. W. Sims, the inventor [illegible] drawn [illegible] Another trial will be made.

THE TELEGRAPH.

Work on the [illegible] Cross, [illegible] King [illegible] Railway company [illegible] fifteen miles of poles are set, and nine miles of wire strung. The line will be completed this month.

A dispatch from San Francisco says: [illegible] a capitalist of Honolulu, arrived to-day on the steamship Umatilla. The object of his visit is supposed to be the formation of a company to construct a [illegible] San Francisco and Honolulu at an estimated [illegible] 000. The Hawaiian government is willing to furnish from $[illegible] to $[illegible], the remainder [illegible] the United States by stock subscription.

A fire was started in the basement of the Board of Trade Building, Chicago, last week, through imperfect insulation of WesternUnion telegraph wires leading underground into the building. The rubber and a few boards of the [illegible] were burned. The only damage was to the [illegible] which were melted, while others were cut, so that the Board of Trade was temporarily cut off from outside communication.

Miscellaneous Notes.

Chas. D. Shain, general district agent of the Westinghouse Electric company, with headquarters at Cincinnati, Ohio, was in Chicago the first of this week He reports business flourishing in his territory.

The Cook County Conduit company, of Chicago has been incorporated to construct conduits for all kinds of wires, cables or small pipes; capital, $25,000. Incorporators: David Sullivan, J. B. Heffernan and Edward B. Healy.

The employes of the Western Electric company of Chicago, enjoyed a picnic at Willow Springs June 15. Seven cars were chartered for the exclusive use of the picnickers. During the day games of base ball, foot ball, racing and other amusements were indulged in, dancing was enjoyed in the evening. The occasion was thoroughly enjoyable.

The city council of St. Paul, Minn., has declared "it is neither wise nor necessary, and the public interests do not require, that any more franchises be given to put conduits and electrical subways in the streets of St. Paul, until the conduit of the National Subway company, now in process of construction, shall be completed and found to be defective, abusive or inefficient."

Business Mention.

Charles L. Ireson of Boston, reports that the sales of self adjusting leather link belting are unusually large.

A. L. Bogart, 22 Union Square, New York, has just completed a new 300-drop annunciator for the Lake Placid hotel.

The catalogue of the Hibbard Electric Manufacturing & Supply company of Montreal is a complete and creditable pamphlet, and will prove an excellent guide for those engaged in construction, as well as the supply companies.

The Woodhouse & Rawson Electrical Supply company (limited) of London held its general meeting May 17th. A dividend of 6 per cent. was declared for the last half year, making a 12 per cent. annual dividend, besides carrying over £13,440.

The Empire City Electric company, 15 Dey street, New York, is manufacturing an improved push button, which affords an absolute rubbing contact, and also obviates all necessity for bending springs or loosening screws in attaching the button. The spring contact will not corrode or weaken.

W. Hackenthal of 21 Beekman street, New York, is introducing the Avon electric counter, which is used extensively in European countries. This meter is constructed so that the amount of current consumed can be seen at a glance, the dials being arranged after the same manner as in a gas meter.

An English paper says: "It is interesting to [illegible] small electric motor work is not standing still. We understand that Messrs. Shippey Bros. have [illegible] A C. motors in Great Britain and France [illegible] six months for driving ventilating fans, sewing machines and other similar purposes."

A. M. McCreery of 18 Cortlandt street, New York, will soon have ready for distribution a handsome catalogue containing cuts of his new specialties. Among these specialties is a new half reflector shade for [illegible]. The shades will be made in [illegible] and the opal being favorite styles. Mr. McCreery has secured a patent for a reflector and [illegible] piece.

The Chicago representatives of the New York Belting & Packing company, W. D. Allen & Co., [illegible]

[illegible] containing description of a [illegible] goods, including belting, [illegible] pamphlet of 40 pages, profusely [illegible] and much labor in its preparation and production. Its possession cannot fail to be of benefit to those interested in Allen & Co.'s line of goods. This firm also handles the Hoyt leather belting, at Chicago.

The Sioux City Engine Works of Sioux City, Ia., reports that the season has been an unusually busy one. The first of the month the Des Moines Electric Street Railway started up a 200-horse power Corliss of their make, which is giving admirable satisfaction. They also secured a large contract, including a 150-horse power Corliss engine, two large boilers and intermediates, for the extension to the Wyatt Park Street railway of St. Joe, Mo. This popular demand for the Sioux City Corliss engine for electric lighting and street railways is accounted for by the fact of recent improvements they have embodied in their valve gear governor, which enables them to guarantee inside of a 2 per cent. regulation between the greatest extremes of load. They are receiving a large number of orders for the well-known Giddings single-valve automatic engines. Among recent sales of the Sioux City Engine Works are the following: One 54x14 boiler for Northey [illegible], Woonsocket, Dak.; one 12x16 [illegible] vertical to Chesterman & Co., city; combined engine and vertical boiler, W. W. Burgess, Pearson, Ia.; one 15-horse power engine and boiler to J. C. O'Donnell, Sheldon, Ia.; one 10x16 automatic for Whitewood, Dak.; one 75-horse power Giddings automatic, New Steel Car Works, St. Joe, Mo., also an 80 horse power boiler and intermediates for the same; one 10x16 engine and boiler, J. M. Starbuck, Cherokee, Ia.; one 14x36 Corliss to St. Paul & Pacific Coal company, West Superior; one 75-horse power Corliss engine and boiler to Nebraska Planing Mill company, Lincoln, Neb.; one 100-horse power engine to S. J. Burns & Co., St. Joe, Mo.; one 75-horse power stationary boiler to Tyler & Co., Marion Junction, Dak.; one 75-horse power Giddings automatic, Geo. A. Galloway, Dell Rapids, Dak.; one 150-horse power Corliss and two 80-horse power boilers to W. J. Hobson, St. Joe, Mo.; two 40-horse power boilers for steam heating, city. The company have been obliged to put on a night force of mechanics in order to run their machinery both night and day, this being found necessary in order to fill contracts promptly. The Sioux City Engine Works have recently sold their present plant, and are now constructing a large new works in the manufacturing town of Leeds. The new works will give them excellent shipping facilities, and a great increase of floor space and facilities in general. In these new works will be placed overhead cranes of the latest improved designs for handling materials, and will give them over double the present capacity in both shop room and tools. This will put them in shape for turning out from 125 to 150 engines per year of an average 100-horse power size each. Plans for the new works now being completed will have an ultimate capacity of about 400 engines per year, and all work and buildings now put up are in accordance with the original plant, which will make these works, when completed, one of the best designed, most conveniently arranged and finest works in the west. The appreciation of the western trade for automatic engines has surpassed the most sanguine expectations of the management.

Electrical Patents.

Issued June 11, 1889.

[illegible]. Incandescent Lamp. Charles A. Backstrom, New York, N. Y.

The object of the invention is the provision of a form of incandescent electric lamp which shall be especially favorable for circuits in which there is a limited current for the working thereof. The essential feature of the invention is the provision of an independent or auxiliary spiral support axially disposed for securing the carbon filament within the lamp.

[illegible]22. Induction Coil. Fred H. Brown, Fort Worth, Tex.

[illegible]. Method of Recording and Reproducing Articulate Speech or Other Sounds. George W. Little[illegible], Pa.

[illegible]. Regulation of Alternating Electric Current Generators. Gustav Pfannkuche, Cleveland, Ohio.

[illegible] electrical distribution, [illegible] alternating current [illegible] dynamo having two [illegible] being included in [illegible] alternating current [illegible] the secondary [illegible] of which is in a [illegible]."

[illegible] of the [illegible] Gustav Pfannkuche, [illegible]

[illegible]

[illegible]

404,866. Electric Signal for Engine Shafts. James C. Ricketson, Milwaukee, Wis.

404,867. Electric Indicator for Engine Shafts. James C. Ricketson, Milwaukee, Wis.

The invention has special reference to devices for indicating at any point distant from the shaft of a marine engine the direction in which said shaft is revolving, as well as its rate of speed.

404,873. Electric Railway. Sidney H. Short, Denver, Col.

The object of the invention is to provide an electric railway in which the cars can be run in multiple arc, and to provide also in such a railway a system of conductors insulated throughout their entire length, except at intervals, by means of insulating material, such as that used for underground cables and for electric light and telegraph wires.

404,877. Underground Conductor. George E. Tailleur, Schenectady, N. Y.

404,893. Elevating Machine. James E. Byrne, Brooklyn, N. Y.

404,894. Electrically Controlled Engine. James E. Byrne, Brooklyn, N. Y.

404,895. Electric Elevating Machine. James E. Byrne, Brooklyn, N. Y.

Claim 3 follows: "The combination, in an elevating machine of a reversible electric motor and a brake connected through a train of mechanism, a switch in the elevator car, contact points, and a battery, the switch, motor, contact points, and battery having suitable electric connections."

404,902. Electrical Distribution System. Thomas A. Edison, Menlo Park, N. J.

The second claim follows:

"2. In an underground system of electrical distribution, the combination, with a street intersection box having pipe openings in its sides, of two or more pairs of conductors, each pair forming the two sides of a circuit, pipes for the separate conductors entering the box, connections within the box of conductors of the same polarity, and a line of conductors forming a feeding circuit entering the box and connected to the intersecting conductors."

404,906. Electric Alarm Clock. William E. Hadlock, Wenham, Mass.

404,913. Insulated Electrical Wire. Henry W. Johns, Jr., New York, N. Y.

The invention consists in applying to the exterior of the wire a practically fire-proof covering of insulating material, composed essentially of strips of asbestos fabric, the meeting edges whereof are united and cemented to each other by interposed cementing material, preferably a vulcanizable substance, and the strips of asbestos material are also preferably composed of a vulcanizable asbestos compound, so that the entire covering may be vulcanized when completed, thus securing fire-proof and water-proof qualities.

404,959. Stop Mechanism for Web Printing Machines. Luther C. Crowell, Brooklyn, N. Y.

404,960. Stop Mechanism. Luther C. Crowell, Brooklyn, N. Y.

404,968. Method of Distributing Electricity by Secondary Batteries. William W. Griscom, Haverford College, Philadelphia, Pa.

The improved method of distribution consists in generating electricity at or near a convenient source of power, conveying it to the point of consumption through the medium of a current of low intensity, storing it in the form of chemical potential, as in a secondary battery, and then simultaneously directing the current from both primary generator and storage system into a working circuit containing translating devices—such as lamps—by which means the generating plant is or may be continuously operated, and the number or character of the translating devices as regards the consumption of energy, thereby may be greatly increased.

404,981. Alarm Signal for Cable and Electric Railway Cars. Louis Pfingst, Boston, and Sumner A. Bemis, Springfield, Mass.

404,992. Speed Indicator. Charles Spratt, New Cross Gate, County of Kent, England.

405,002. Brush Holder for Dynamos. Walter S. Bishop, New Haven, Conn.

405,010. Electrically Controlled Engine. James E. Byrne, Brooklyn, N. Y.

405,045. Magnetic Machine for Removing Mineral Substances from Grain. Martin L. Mowrer, Dayton, Ohio.

The invention consists in the construction and arrangement of a series of magnetic wheels in a grain spout or chute for removing particles of iron, steel, or other mineral substances from the grain during its passage through said spout.

405,0[illegible]. Electric Self Winding Clock. James H. Gerry, Brooklyn, N. Y.

The invention belongs to the class of clocks which wind themselves through the action of an electro-magnet and are known as "step by step" winders.

405,121. Discharge Device for Electrical Machines. Albert [illegible], Allegheny, Pa.

[illegible] relates to the construction of a device for preventing the occurrence of injurious disruptive [illegible] between the coils of an armature [illegible] and the soft iron core.

The fourth claim is as follows: "A discharge device [illegible] consisting of a stationary support [illegible] interposed between the belt wheel and the body of the machine, and an arm carrying the plate adjustable in said support."

405,126. Automatic Gas Lighting and Extinguishing Apparatus. Nathaniel H. Shaw, Somerville, Mass.

405,151. Electric Temperature Regulator. Lucien F. Easton, La Crosse, Wis.

405,170. Manufacture of Filaments for Electric Lamps. Hiram S. Maxim, Brooklyn, N. Y.

The second claim is appended:

"The mode of heating the carbonized conductors for incandescent lamps, which consists in subjecting them in the presence of a hydrocarbon or equivalent vapor to the action of an electric current until by the decomposition of said vapor their illuminating power is brought to the same intensity as that of a standard lamp included in the same circuit or in a branch thereof."

405,174. Regulation of Alternating Electrical Current Generators. Gustav Pfannkuche, Cleveland, Ohio.

Claim 4 follows:

"In a system of electrical distribution, the combination, with an alternating current dynamo and a separate exciting dynamo provided with separate sets of field magnet coils, of inductoriums constructed to transform and reduce the tension of the current of the alternating current dynamo and connections for utilizing such secondary currents for energizing separate sets of field magnet coils of the exciting dynamo."

405,176. Electrode for Electro Therapeutic Bodywear. Harry P. Pratt, Chicago, Ill.

405,187. Electric Drilling Machine. Elmer A. Sperry, Chicago, Ill.

405,188. Electric Mining Machine. Elmer A. Sperry, Chicago, Ill.

The third claim follows:

"3. In a mining machine, the combination of a suitable supporting frame with a drill, a driving spring for said drill, an electric motor to energize said spring, and an intermittently and irregularly operating catch consisting in part of a slotted pitman attached to and moving with the drill or drill-rod, said catch adapted to intermittently connect the spring and motors, so that their re-engagement is dependent upon the length or duration of the effective stroke of the drill."

405,194. Electro-Magnetic Transmitter. John T. Williams, Mount Vernon, N. Y.

405,196. Galvanic Battery. John A. Barrett, Brooklyn, N. Y.

405,206. Electric Alarm Clock. Benjamin Dubinski, St. Louis, Mo.

405,211. Quadruplex Telegraphy. Charles D. Haskins, Brooklyn, N. Y.

In the working of quadruplex systems of telegraphy a false signal has been caused at the neutral relay when the polarity of its current is changed by the double current transmitter at the distant end during the time that the armature of said neutral relay should be held up by the operation of the single current transmitter.

The invention relates to devices for preventing such false signals, and it consists in providing an extra electro-magnetic device to the neutral relay in circuit with an extra helix provided on the neutral relay magnets. The current induced in the extra coil or helix serves to energize the extra electro-magnet, so that the armature lever of the neutral relay, instead of falling away or kicking, as it has done heretofore, is held in position by the extra electro-magnet and armature.

405,213. Secondary Battery. Thomas H. Hicks, Detroit, Mich.

The second claim is appended:

"A storage battery consisting of two dissimilar bodies, one consisting of a perforate and an imperforate lead plate inclosing a body of spongy lead between them, and the other consisting of carbon or its described equivalents."

405,218. Dynamo Electric Machine. Osborn P. Loomis, Somerville, Mass.

405,221. Testing Apparatus for Switch Boards. William E. McKivitt, St. Paul, Minn.

The objects of the invention are, first, to enable either of two connected subscribers to connect with the operator's telephone automatically by throwing down the clearing-out shutter; second, to arrange the circuits in such a manner that the plug of either cord of a pair may be used to test whether a spring jack has a line connected to it or not; third, to provide a clearing-out shutter whereby the test circuit is closed when the shutter is thrown down to announce a clearing out signal, and, fourth, to provide apparatus whereby the operator may at will connect with the pair of cords while either of two subscribers connected through the conductor or strand of said cords may automatically make connection with the operator's telephone.

405,223. Electric Motor Starting and Stopping Device. Frank A. Perret, Brooklyn, N. Y.

405,235. Municipal Signal Apparatus. John C. Wilson, Boston, Mass.

405,239. Apparatus for the Manufacture of Filaments for Incandescent Lamps. Hiram S. Maxim, Brooklyn, N. Y.

The third claim is given:

"The combination of an electric circuit, a carbon holder, a receiver for inclosing such holder and arranged to be provided with an atmosphere of hydrocarbon or equivalent gas for building up the carbon and changing its resistance, a standard light and a photometer."

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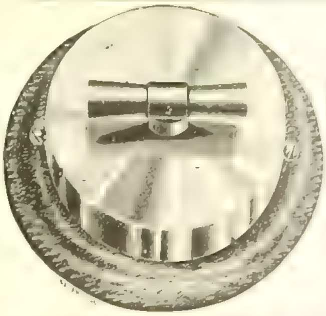

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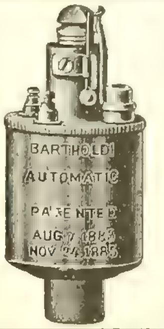
HENRY A. CLARK, General Manager. HERBERT H. EUSTIS, Electrician.



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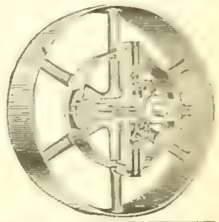

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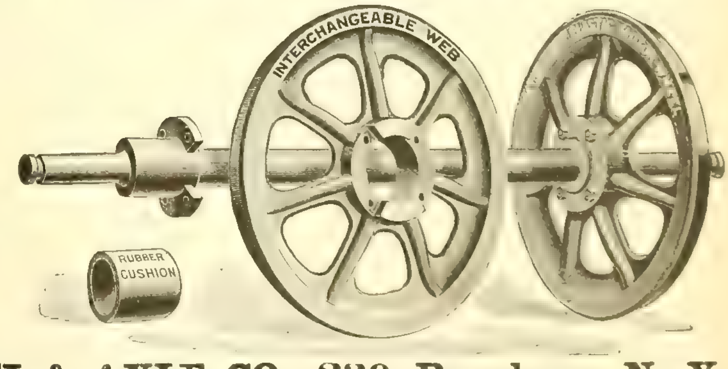

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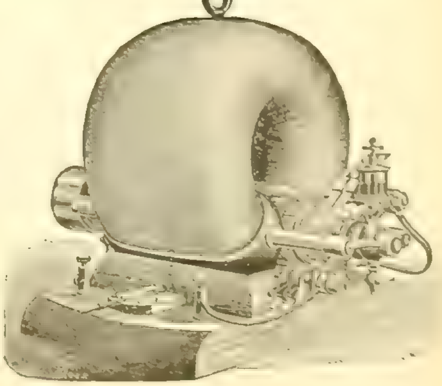

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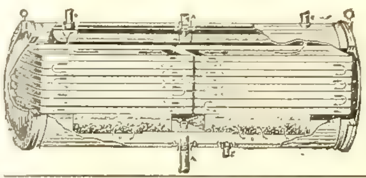
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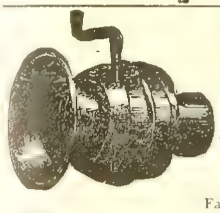
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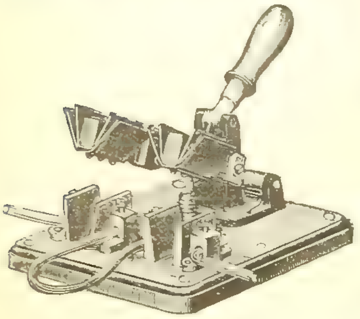
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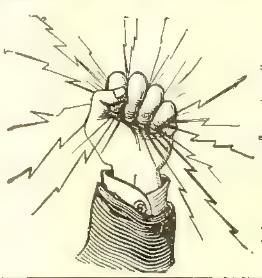
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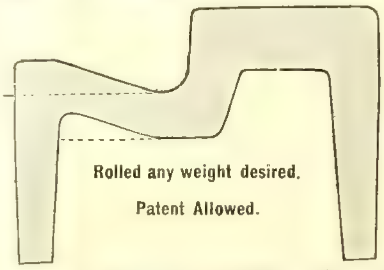

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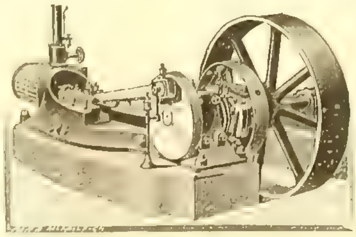

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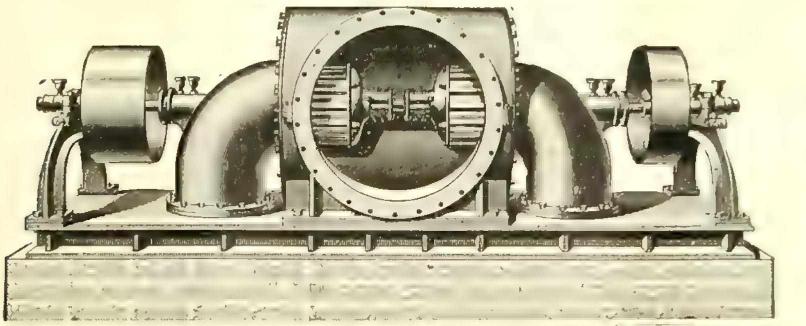

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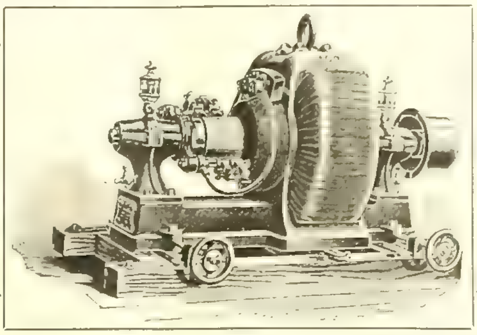

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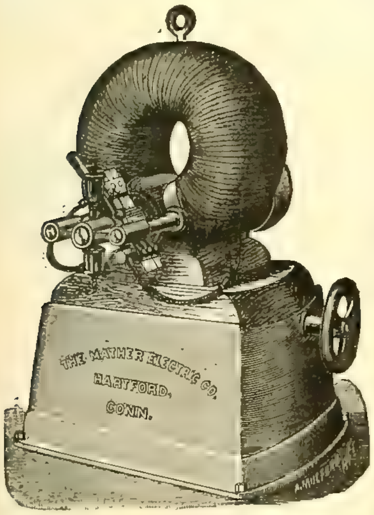

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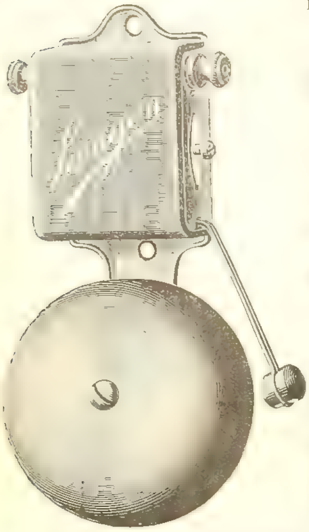

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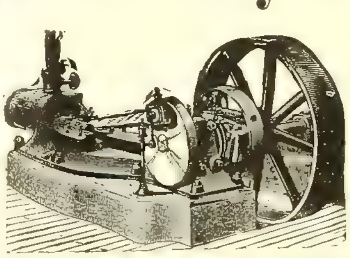

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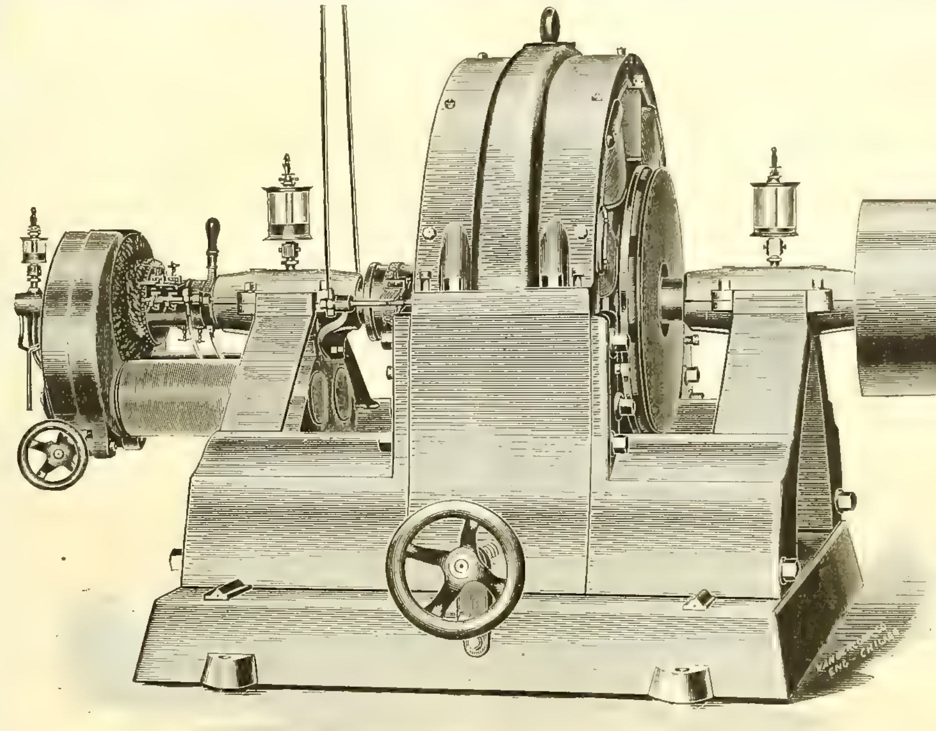

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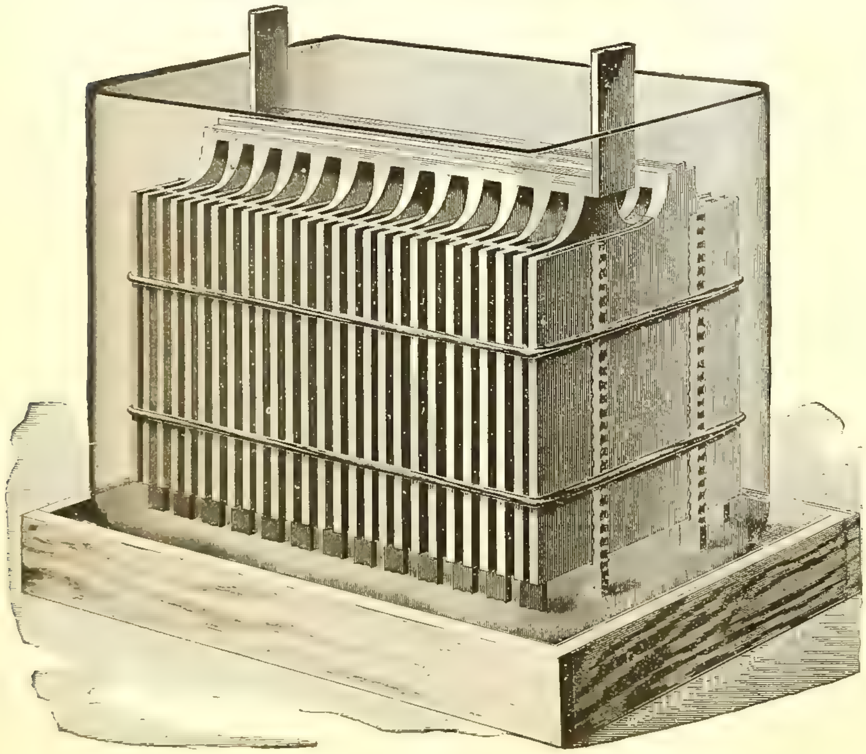

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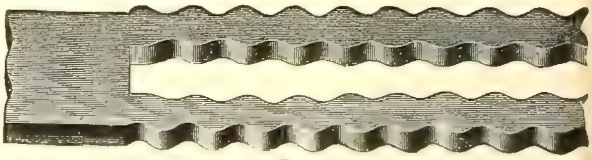

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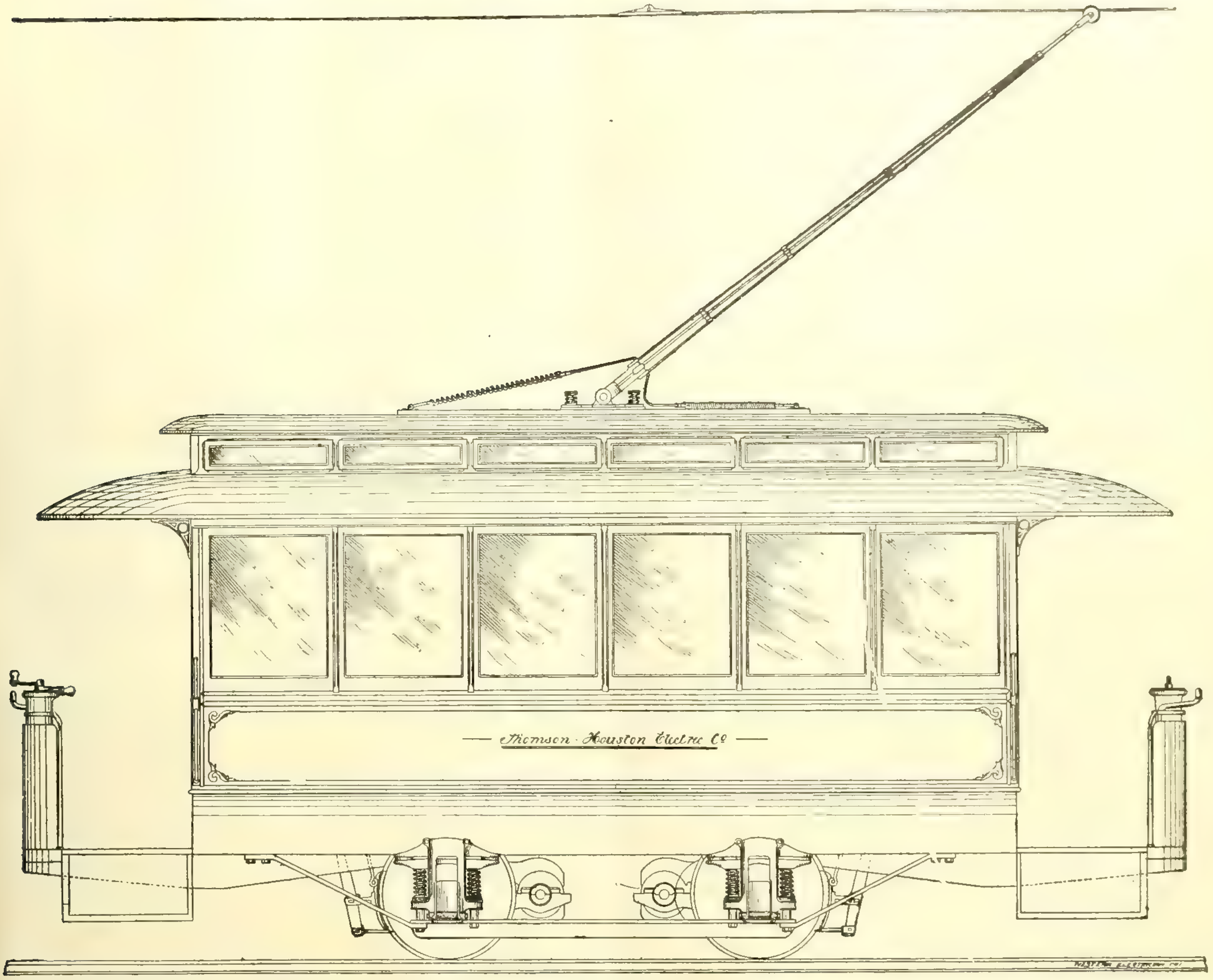

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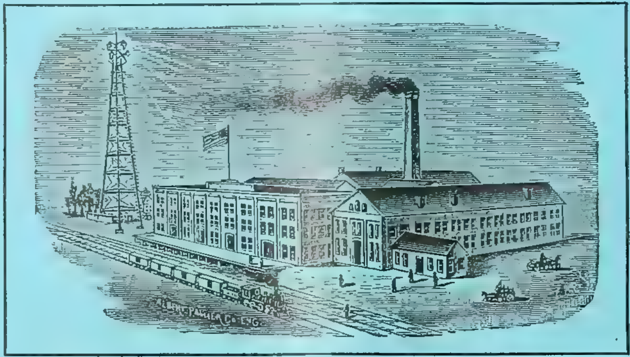

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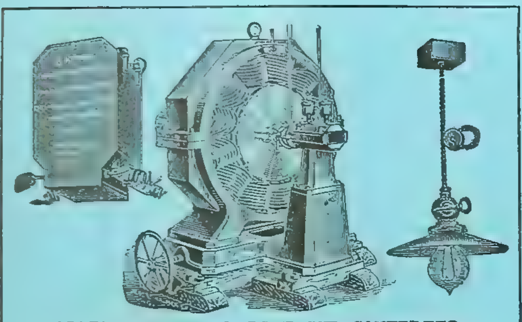

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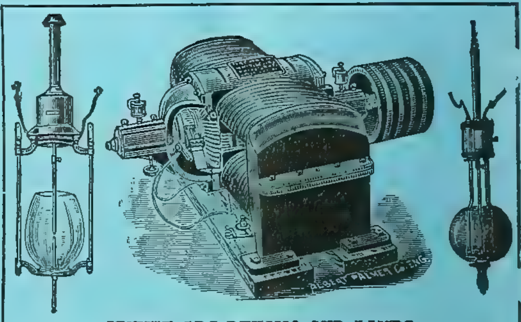

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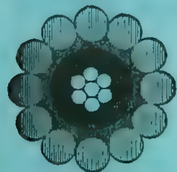

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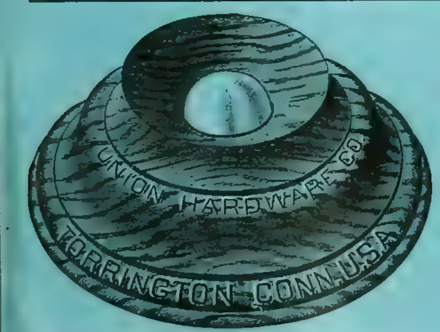

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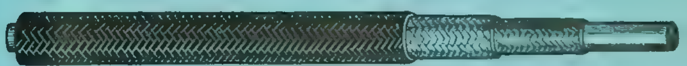

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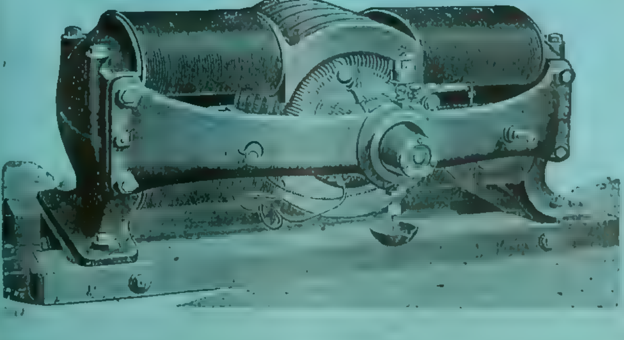

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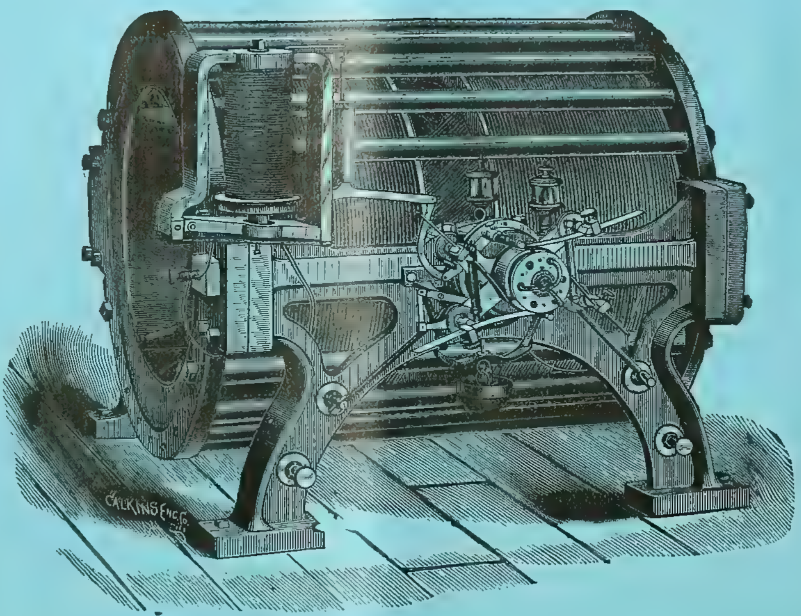

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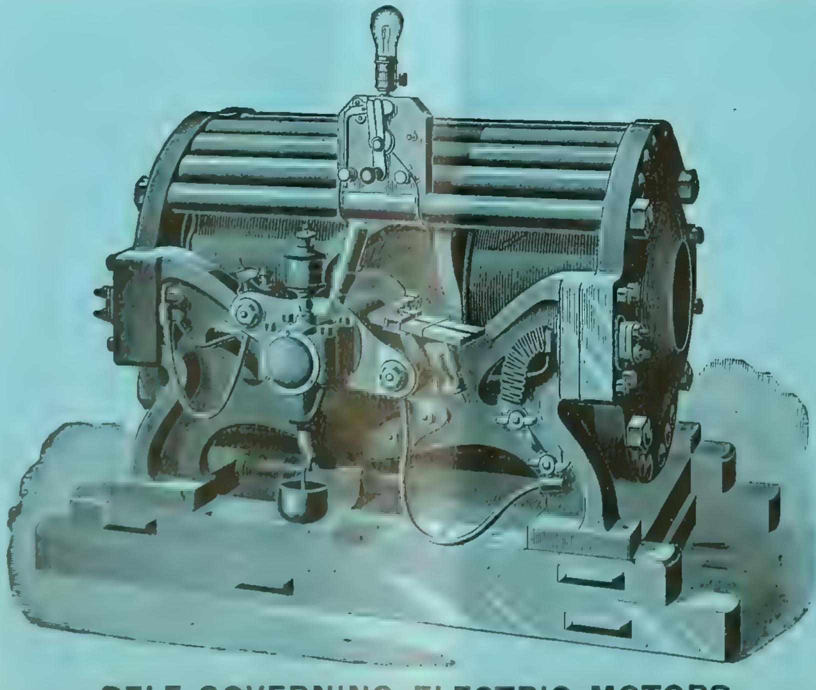

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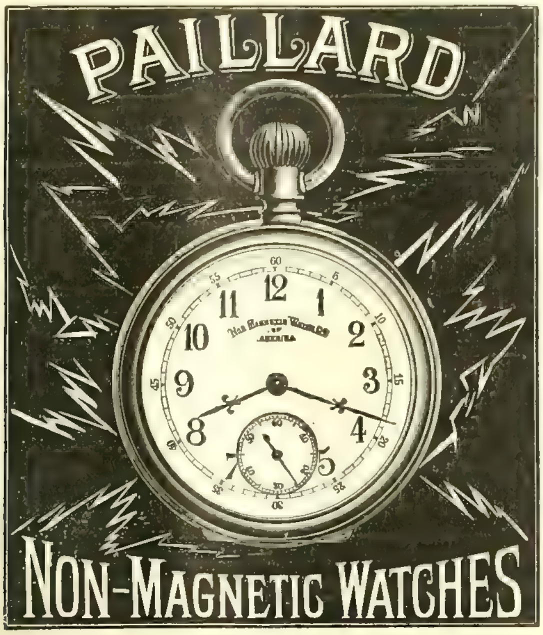

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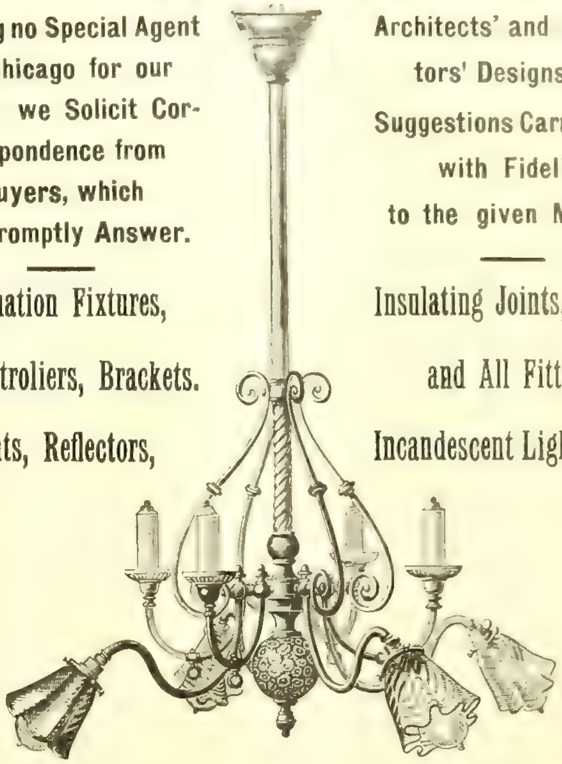

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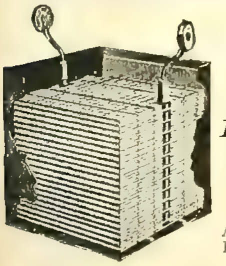

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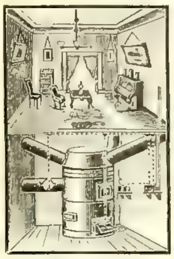

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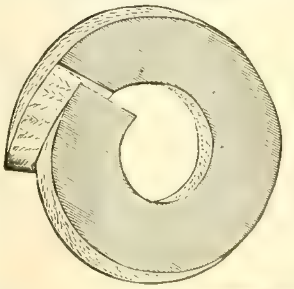

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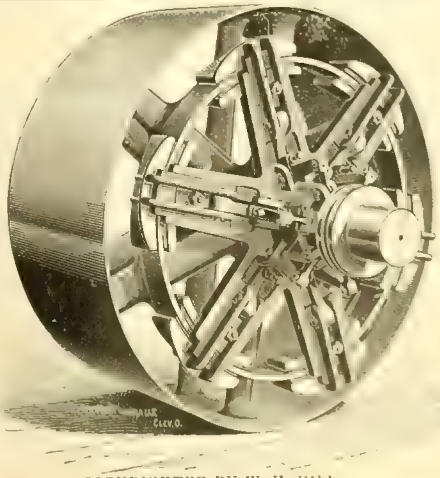

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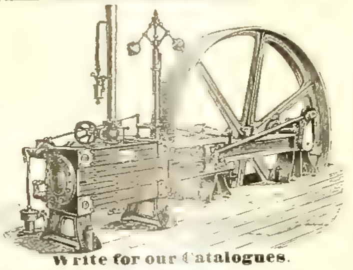

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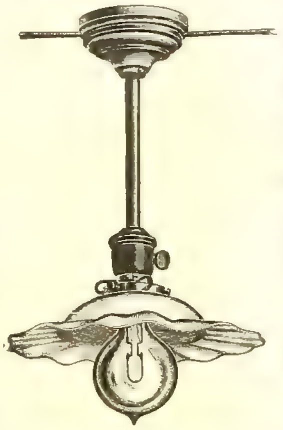

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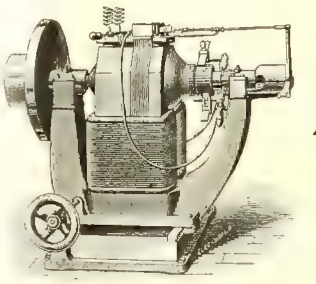

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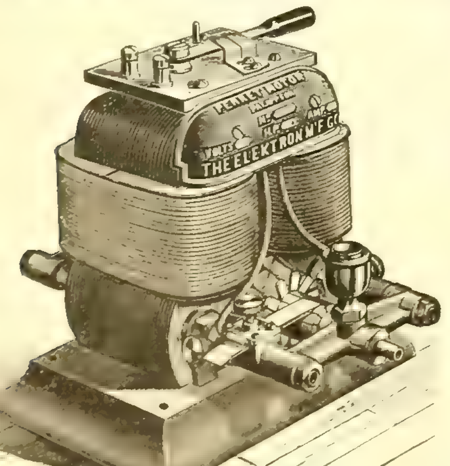

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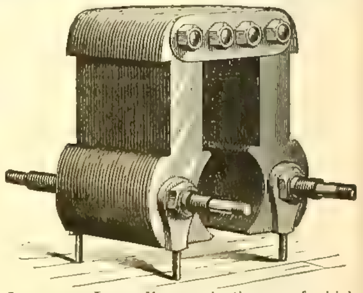

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Hence the delay in establishing our rights. In the meantime, other electrical companies have been indiscriminately copying our devices and methods, not even assuming that they themselves were the original inventors, but simply relying upon the construction of a statute by the lower courts invalidating our fundamental patent. In pursuance of our expressed determination to secure a decision upon the point of law involved, we have had the Bate Refrigerator case (covering the identical question) argued before the U. S. Supreme Court, with the result announced above, thus

Completely Depriving the Defendants of their Main Defense.

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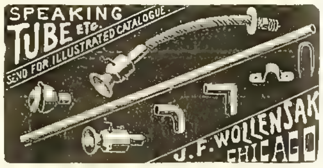

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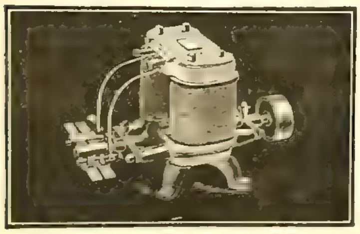

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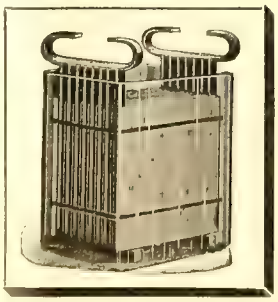

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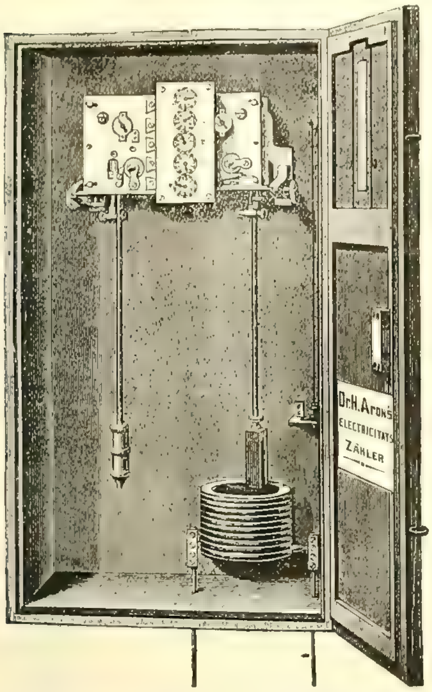

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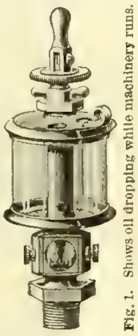

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Fig. 1. Shows oil dropping while machinery runs.

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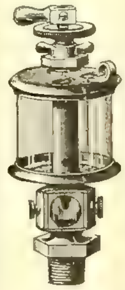

Fig 2. Shows flow of oil stopped when machinery stops.

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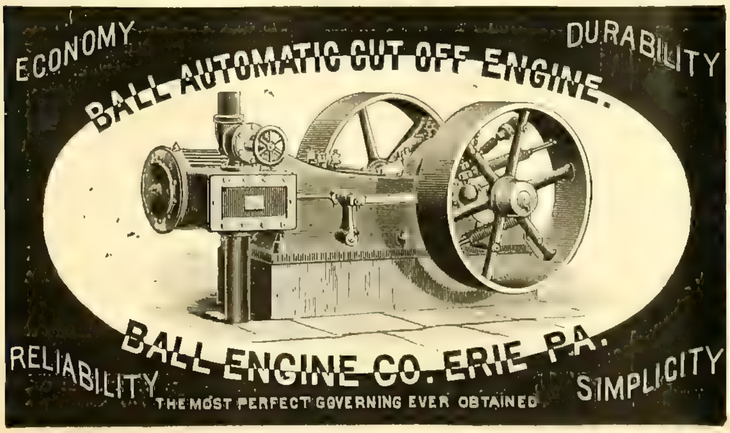

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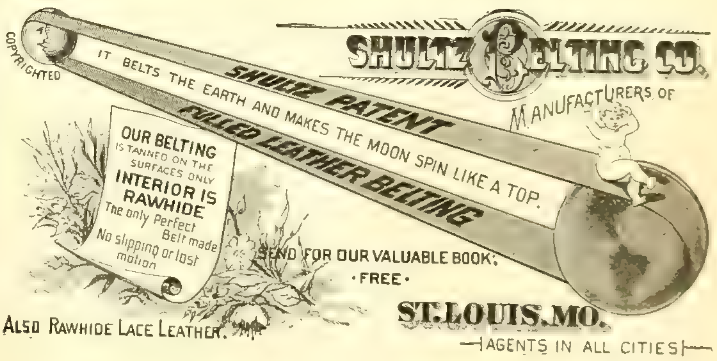

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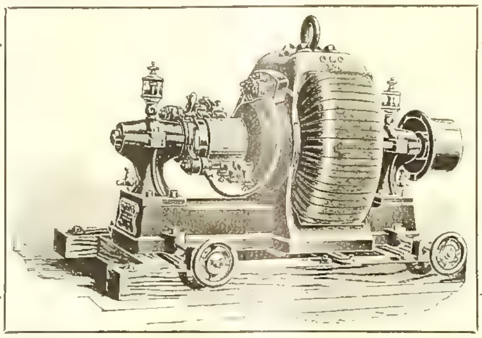

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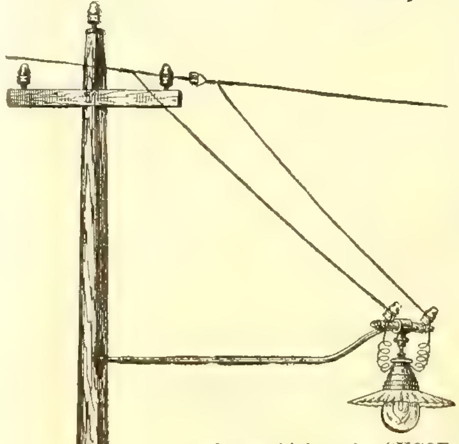

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Vol. IV. CHICAGO, JUNE 29, 1889. No. 26

Electric Light Plant in the Indianapolis Union Depot.

The electric light plant in the Union depot in Indianapolis is illustrated in the accompanying cuts. The plant consists of three incandescent dynamos of a capacity of 300 amperes each at 100 volts, and two arc dynamos, of a capacity of 35 2,000 candle power lamps each, the normal current being 22 amperes; also one new type Jenney shunt wound dynamo of 200 ampere capacity for all day use, operated by an independent engine. The power plant consists of two right and left hand double valve Buckeye engines with cylinders 15x18 inches, running at 245 revolutions per minute, either of which is capable of driving the whole load. The apparatus throughout is of the Jenney system, and was manufactured and installed by the Indianapolis Jenney company. The shaft, carrying the driving pulleys is 4½ inches in diameter by 37 feet. long, and is of steel. Strictly speaking, two pieces of shafting are used, each 18 feet 6 inches long, arranged for connection in the center by friction clutch couplings. Each engine is arranged to connect directly to each end of the shaft by a clutch coupling. This arrangement makes it possible to operate the entire shaft, including all the dynamos, by either engine. Both engines may be coupled to the shaft and used together, or the shaft can be divided in the center and one-half of the load driven by each engine. This arrangement proves in practice to be very convenient. All the driving pulleys on the shaft are provided with friction clutches, so that any dynamos can be stopped at any time. Transferring the load from one engine to the other while the plant is in operation can be effected without causing the least waver in the lights. One dynamo can be thrown out of circuit, shut down and started, and again thrown into use without affecting in the least the steadiness of the lights.

The three incandescent dynamos used for night service are plain shunt wound machines. The armatures are of the Gramme type, wound with one layer of No. 5 wire; two wires in parallel to each section. The arc dynamos are of the standard Jenney type, series wound and provided with Mr. Jenney's automatic regulators, which make possible switching off all the lights, running the machines on dead short circuit, maintaining the normal current at all times, regardless of varying load or speed.

The dynamos are placed upon neat brick foundations. The wires leading to the switch-board are of okonite, and are placed under the floor. The main building, east and west baggage buildings and tunnel, are wired throughout with okonite wire. The plant has now been in operation nine months, and the insulation resistance is something over one megohm. The incandescent lights, 1,200 in number, are distributed throughout the main building, east and west baggage buildings and tunnel. The arc lights, 64 in number, are in the train sheds and around the main building.

The lights, both the arc and incandescent, were located according to the specifications of Thomas Rodd of Pittsburg, the architect and designer of the building, and to the judicious placing of the lights is due, in a great measure, the brilliant effect produced. The arrangement of the circuits is admirable. Six sub-distributing points are arranged and located on each floor on both sides of the main waiting room, and from these points all the chandeliers and brackets, except the four main electroliers in main waiting room, are wired with independent circuits. Here also are placed double-pole safety fuses for each chandelier and bracket in addition to a double-pole safety fuse at the base of each chandelier and bracket, thus sub-dividing the safety fuses, so that not more than six lights are on a single fuse. Independent feeders are run from these distributing points directly to the main switch-board. The chandeliers in the dining room, lunch room and ladies' waiting room are wired with two circuits with two switches conveniently located in each room, by turning one of which one-half of the lights can be switched off in each room. The circuits in the chandeliers are so arranged that each alternate group is turned off, thus leaving those that remain burning evenly distributed.

The four large electroliers in the main waiting room shown in Fig. 3 are wired similarly, except that the circuits are double and independent. Two positive mains run directly from the main switch-board to a point near the center of the attic. From these, two wires are run to each electrolier, and thence to a small switch-board located in the station master's office on the first floor. From this point one main carries the current from all the electroliers back to the switch-board. On this little switch-board are arranged eight switches, two for each electrolier. By this arrangement any number of lights from one half of one electrolier to all the lights on all the electroliers can be switched on or off, as occasion may require. The four large electroliers are arranged by wire cable and counterpoise to be lowered to the floor a distance of 30 feet while the current is on, thus greatly facilitating the replacing of burned-out lamps. Each electrolier is 35 feet long, weighs 650 pounds, and has 60 lights.

Each baggage building as well as the tunnel has a separate circuit running independently and directly from the main switch-board. The main switch-board is the remarkable feature of the whole plant. It is located in the dynamo room and is made of 1½ inch sawed red oak with hard oil finish. It is of cabinet form, 10 feet long, 9 feet high, and 3 feet deep. It is accessible

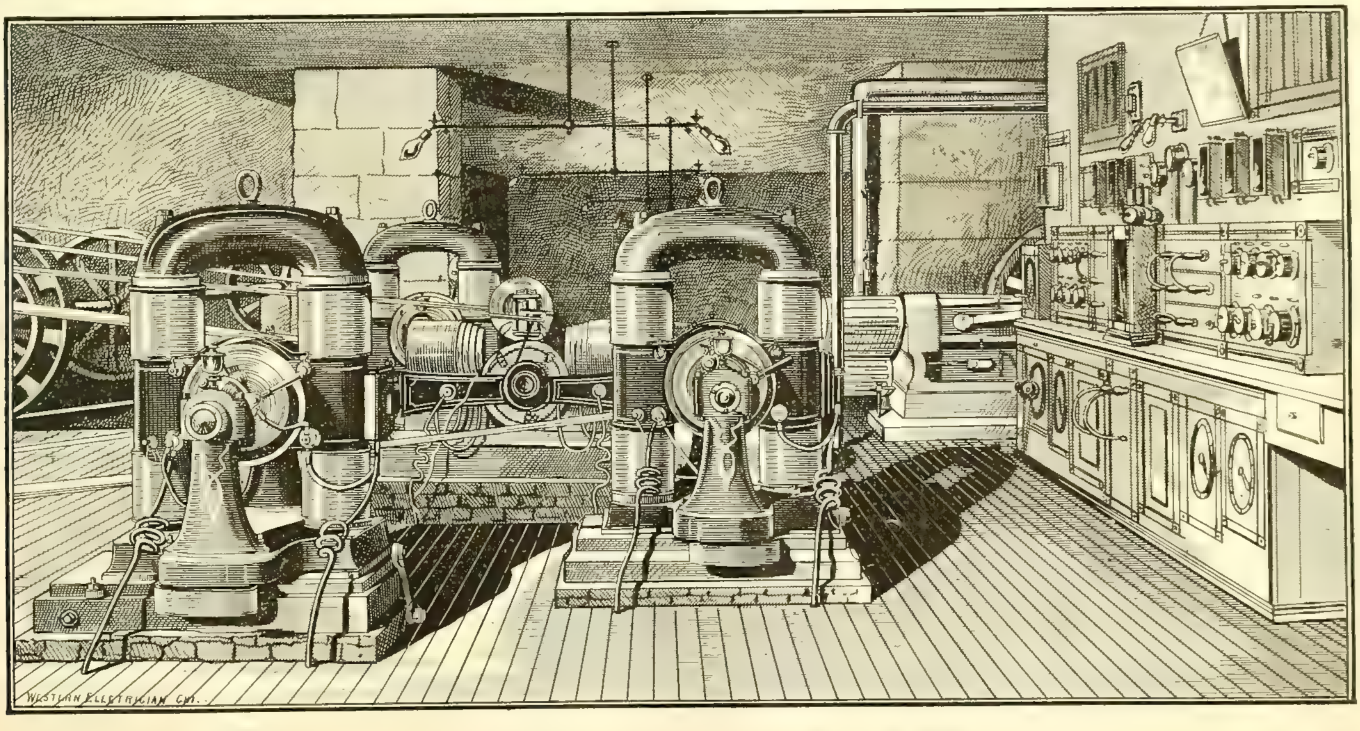


FIG. 1. ELECTRIC LIGHT PLANT IN THE INDIANAPOLIS UNION DEPOT.

the rear by large folding doors, so the entire interior is exposed for inspection.

Incandescent lamps are arranged with flexible cables for minute inspection. Upon the board are arranged in a very neat and symmetrical manner all the indicating instruments and regulating devices. They consist of a hand rheostat, voltmeter and ammeter for the day machine and hand rheostat, voltmeter and ammeter for each of the three night machines, also an am-

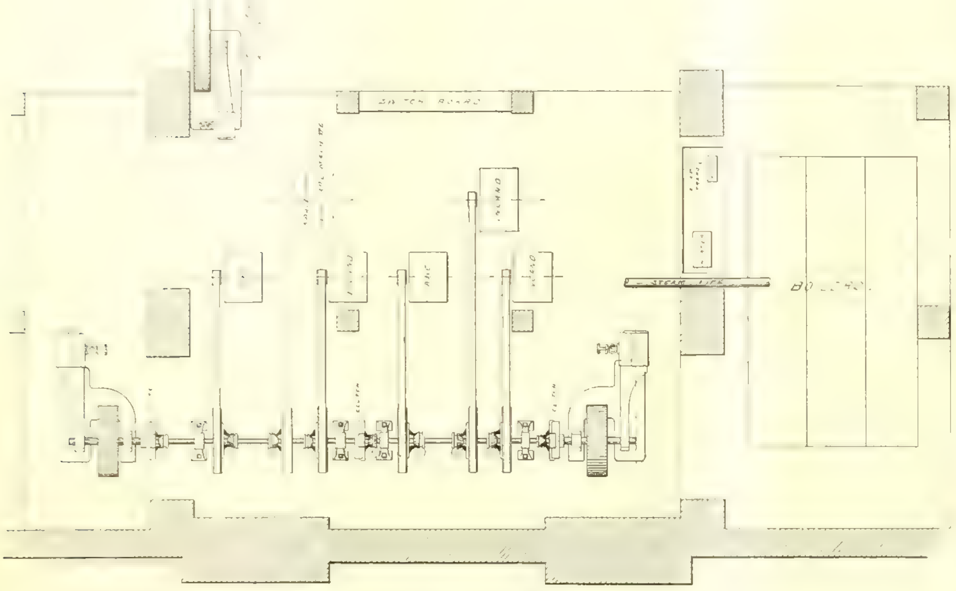


FIG. 2. ELECTRIC LIGHT PLANT IN THE INDIANAPOLIS UNION DEPOT.

meter of 1,000 ampere capacity, through which the current from all the machines passes and is indicated. A double-pole safety fuse and switch are here located in every main circuit in the main building, baggage buildings and tunnel. By this means all the lights in the entire plant are controlled from this point, and they can all be switched on or off in less than a quarter of a minute. There is also an automatic regulator arranged for the three night machines, when run in parallel, which will correct any slight variation of potential due to change of load or variation of speed. In the center of the board is a projecting portion forming a small cabinet provided with a glass door in which are arranged the electro-magnetic "directors" or relays for governing the two arc and the incandescent automatic regulators. Mounted at the top of the cabinet is a small motor that furnishes power for shifting the lever which carries the trailing finger over the face of the automatic regulator.

Large double-pole fuses are placed in the mains leading from each dynamo, just before they are connected to the bus wires in the switch-board. The supply of current for the fields of each dynamo is taken directly from the main bus wires at the switch-board, thus connecting all the fields as well as the mains together in multiple. The circuits and bus wires are so arranged that all or any one of the machines can be separated or run independently.

[illegible] provided with a break-down [illegible]h in main circuit. The voltmeter for each machine takes current from the brushes directly.

[illegible] connected directly to the [illegible] board, and usually [illegible] about 150 lights, the re-[illegible] As evening ap-[illegible] and then the [illegible] The day [illegible] the first of the night dynamos can carry the load.

[illegible] to be the most [illegible] in the country.

[illegible] of [illegible] of the Jenney company's superintendent, A. W. [illegible]

manufacture of all the electrical apparatus constituting the plant. The work of placing the wires and connecting up, etc., was in charge of the company's expert, T. A. Wynne.

It has been stated that a new type of Jenney incandescent dynamo is in operation in the plant, and is used on the day circuit. A view of the machine is shown in Fig. 4. It is widely different from those in general use. The armature, field magnet, and the shape of the pole pieces, are the characteristic features of this machine.

It has been the aim of the inventor, Charles D. Jenney, to produce a magnetic field of enormous strength, which will at the same time be economical to maintain. By studying the direction of the magnetic lines of force about a straight bar magnet the inventor was led to design the form of magnet shown. The natural

FIG. 3. ELECTRIC LIGHT PLANT IN THE INDIANAPOLIS UNION DEPOT—ELECTROLIERS IN THE WAITING ROOM.

direction and curvature of the lines of force, as they pass through the [illegible] from one pole to the other in a bar magnet, are well known. In this machine the pole pieces were made to correspond to the natural curvature of the lines of force, thereby reducing the length of the magnetic circuit and the resistance, to a minimum. The magnet core is made of the softest of wrought iron, and is [illegible] back from each end the same diameter to which the pole pieces are

turned. On the farther end of the pole pieces perpendicular slots extend from the core, and by means of bolts they are firmly clamped to the core, thus securing a most perfect magnetic union between the respective parts.

The armature, although of the drum type, is quite different from anything heretofore made. The core is built up of thin iron disks, all of which are securely fastened to the shaft. No wires are wound over the ends of the core, but special heads are provided which complete the connections at the ends. These heads are so constructed and insulated that short-circuiting between their parts is almost impossible. One special feature claimed for this armature is, that any wire can be removed without interfering with any of the remaining ones. There is but one layer of wire on the armature, and but one turn to each section; the resistance, therefore, is low.

In addition to the insulation on the wire, there is an air space provided between each wire, affording thorough ventilation. On account of the great strength of field, but very little wire is required to produce the desired electromotive force.

As the length of wire on the armature is reduced, and the strength of the field increased, the current that circulates through the armature coils has but little de-magnetizing effect, and the variation in the "lead" of the brushes, from nothing to full load, is slight. It may also be added that these machines run without sparking.

At the ends of the armature insulating disks are provided that prevent dirt or copper dust from getting into it, and as they are larger in diameter than any other part, they serve as guides to prevent injury to the bands and wire on the armature, when it is being taken out, or put in place.

These machines are shunt-wound, but with constant speed they govern very closely, under changes from nothing to full load. The normal rating of the machine illustrated is 200 amperes at a pressure of 120 volts. The field magnet requires only about 1 per cent. of the total current. It is claimed that the electrical efficiency of this machine is 97 per cent. Machines of this type are built throughout with a view to great strength and durability.

Electric storms continue to prevail throughout the country. On June 21st there was a general storm and two lives were lost, one at Vandalia, Ill., and another at Scranton, Pa. Many persons were prostrated and several sustained severe shocks, but it is hoped all will recover. At Decatur, Ill., the city electric light plant was destroyed, and the city left in darkness. A large amount of property was destroyed.

The Schoop Storage Battery.

Among the defects to which the ordinary storage cell with pasted plates is subject are two of a mechanical nature, viz., buckling of the plates, and the falling out of the active material, says *Industries.* While buckling may, perhaps, be prevented by a proper method of constructing the grids and supporting them, the disintegration of the active material must be

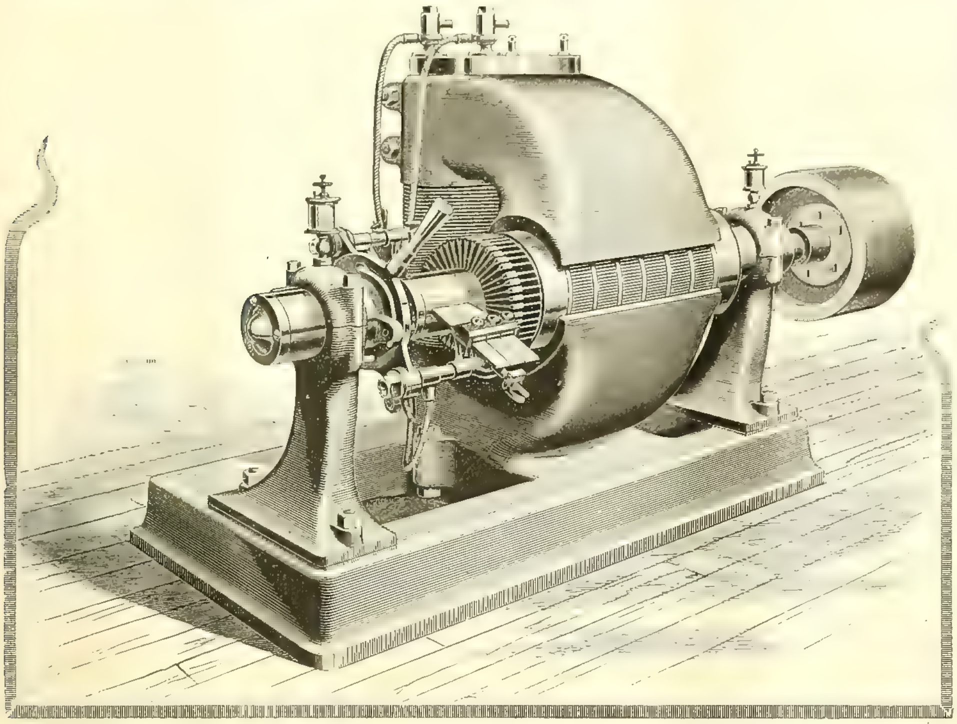
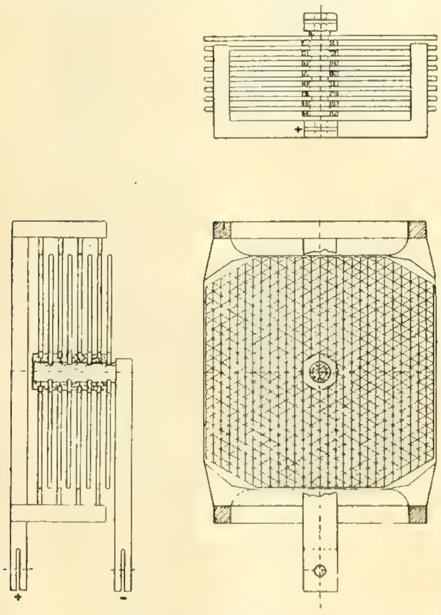


FIG. 4. ELECTRIC LIGHT PLANT IN THE INDIANAPOLIS UNION DEPOT—NEW TYPE OF JENNEY DYNAMO.

regarded as a necessary evil; and a glance at a battery which has been in use for some time will show, by the black deposit on the bottom of nearly every cell, that a process of gradual deterioration is going on. The two defects mentioned, although apparently of a purely mechanical character, are in reality due to the chemical changes which take place when the battery is charged and discharged. The life of the positive plates is more especially shortened



SCHOOP STORAGE BATTERY.

by quick charge or discharge, by complete discharge, and by the employment of a too concentrated electrolyte. Several plans have been proposed to prolong the life of plates by retarding the process of disintegration, but it cannot be entirely prevented; and when it is attempted to mechanically protect the active material, the free access of acid to its interior, and the free escape of gas, are rendered more difficult. These considerations have led Dr. P. Schoop of Zurich to turn his attention to the employment of a solid or semi-solid electrolyte, which, although it does not prevent the disintegration of the active material from taking place, prevents at least its falling out. The construction of the Schoop storage cell will be understood from the accompanying sketch. The grids are made of an unoxidizable alloy and with triangular holes, which are filled with active material. The precise composition of this material, as well as that of the solid electrolyte, is as yet kept secret; but the amount of litharge contained in a given volume of his paste is only two-thirds of the amount ordinarily employed. If the plates thus formed be allowed to "sulphate," through being completely discharged and left standing, the plate containing the larger amount of litharge will buckle, while the other will remain straight. The buckling and disintegration are often promoted by unequal current density over the surface of the plates. When the current is distributed from the top of the plate the upper portions of the surface must necessarily have a larger current density than the lower portions, and become more quickly charged. Dr. Schoop arranges the connections in such a manner as to [illegible] tration. The resistance offered by any path is, therefore, approximately [illegible] of the surface, and every part [illegible] upon by the current. All the negative grids are connected with the central stem, forming a prolongation of the electrode, and [illegible] through central holes of larger diameter [illegible] positive grids, which are separated [illegible] insulating washers. The smallest size [illegible] made contains eleven plates, 5 inches square and .1 inch thick. The plates and connect[illegible] weigh 10 pounds, the electrolyte [illegible] pounds, and the ebonite box 1.1 pounds.

Fort Wayne vs. Westinghouse.

In the WESTERN ELECTRICIAN of June 15th it was stated that the Fort Wayne Electric Light company had begun an action against the Evansville Gas & Electric Light company, which uses the Westinghouse company's system, for alleged infringement of patents. The contest will be made over the claims of M. M. M. Slattery, in patent No. 386,936, issued to him July 31, 1888, for a system of electrical distribution. The specifications were filed April 5, 1888. Mr. Slattery claims that these specifications cover all forms of the present alternating current systems for electric lighting. He has assigned the patent to the Fort Wayne company, and it proposes to test the validity of the claims. This is another step in the litigation which was begun by the Westinghouse company's suit against the Sun company and Mr. Slattery. The Fort Wayne company undertook the defense of this former suit, and was successful. The outcome of the present suit will be awaited with interest.

Atlantic City Electric Railway.

The accompanying engraving gives a view of one of the Sprague electric cars in operation at Atlantic City, N. J., drawing one ordinary car. The line has been in operation for about six weeks, and during this time the cars have made 6,464 trips without the loss of a singe trip, although there has been no reserve cars to supplement those in use. The original order of the Pennsylvania company, which controls the system of street railways at Atlantic City, was for six cars, each to be equipped with two 15 horse power Sprague motors, and each to be capable of drawing an ordinary street car. Since the demonstration of its successful operation at At-

SPRAGUE ELECTRIC RAILWAY AT ATLANTIC CITY.

lantic City this order has been increased to six- [illegible] cars, [illegible] of drawing an [illegible]tional car. The poles are of iron throughout the entire length of the line, and are placed [illegible] the double bracket method of support for the trolley wire. These poles, which were put up by the Pennsylvania Railroad company, show how unobjectionable a system using overhead wires may be when [illegible] the [illegible] of the [illegible].

[illegible]

Belding Motors.

The accompanying cuts show two of the departments in the factory of the Belding Motor Manufacturing company, Chicago. Also a few applications of the motors in practical work. This company was organized in December, 1887, to manufacture under the patents of Warren S. Belding. In May, 1888, work was started in the present factory corner Van Buren and Clinton streets, and since that time the company [illegible] its working force [illegible] it employs from 30 to [illegible] only small motors [illegible] company is now in a pos[illegible] machines of 15-horse power and exp[illegible] to bring out still larger sizes.

Fig. 1 illustrates the winding room in the factory. The room is well lighted and all machinery is driven by a Belding incandescent motor.

Fig. 2 gives a view of Mr. Belding's test room showing the dynamometer on which the motors are tested, and other instruments for the necessary experimental work. Current is furnished for testing and to operate the winding room motor and another in the machine shop, from two Edison 120 light 110 volt machines. By the employment of two machines a potential of either 110 or 220 volts may be obtained when desired.

Fig. 4 shows a 2-horse power Belding motor in the shirt factory of G. L. Morganthau & Co., Chicago, running a long line shaft thirty or

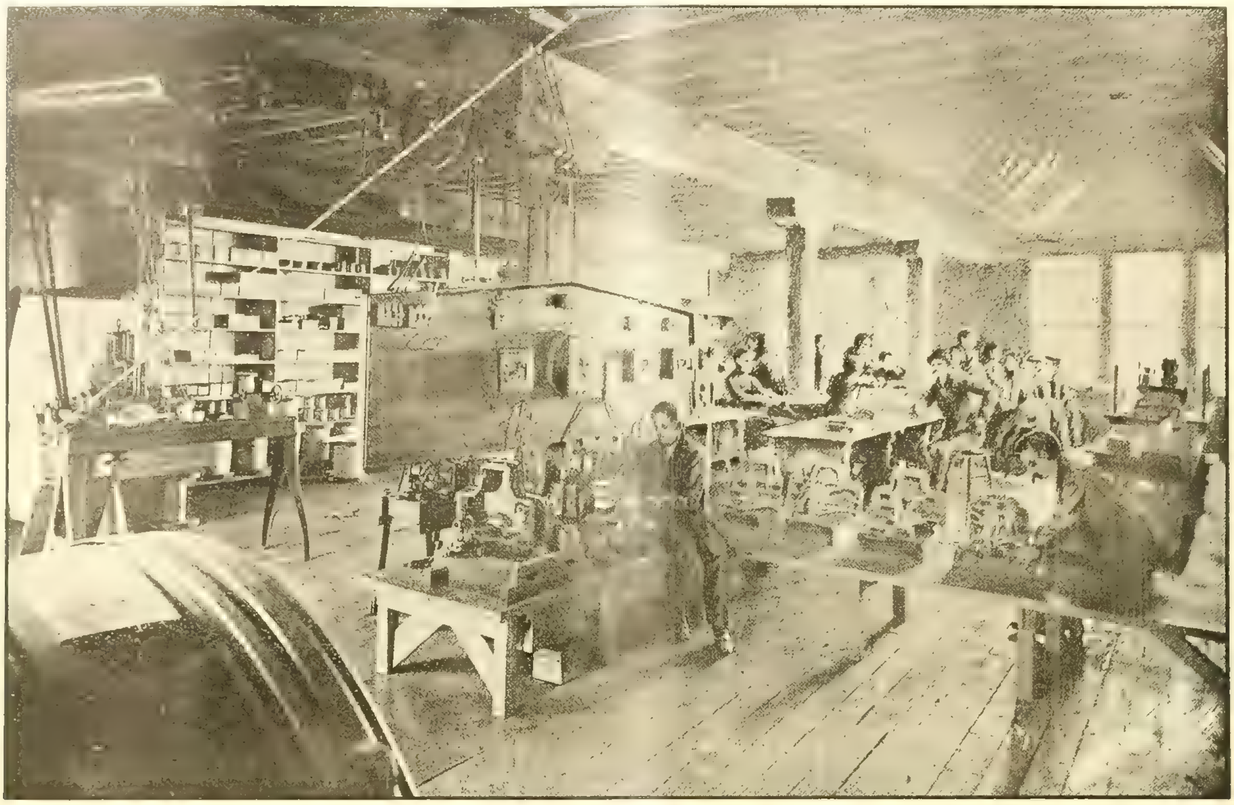


FIG. 1. WINDING ROOM IN THE BELDING MOTOR FACTORY.

FIG. 2. [illegible] MOTOR FACTORY.

forty sewing machines and ironing and plaiting machinery.

Fig. 3 shows an application of the larger size incandescent motor to direct elevator work.

Fig. 5 represents a section of a large building in which a 7½ horse power incandescent motor owned by C. L. Palmer, printer, is supplying power to a number of printing offices on the other floors of the building.

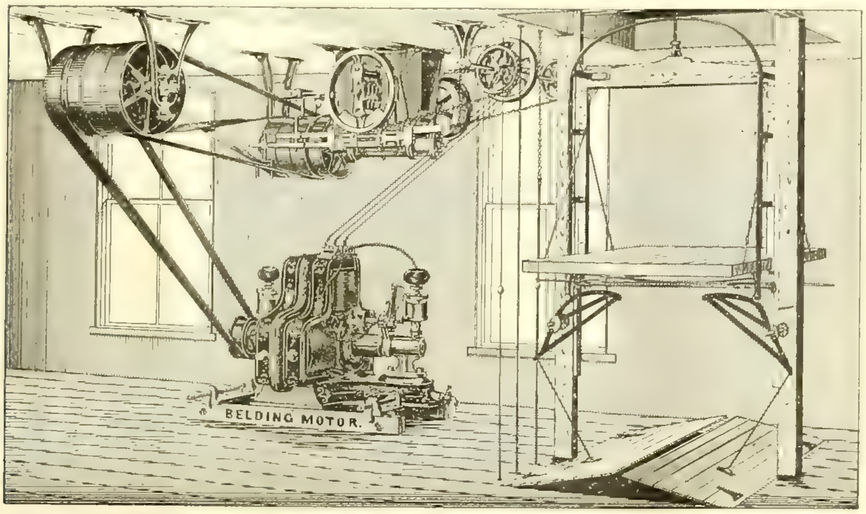


FIG. 3. BELDING MOTOR FOR ELEVATOR WORK.

The Belding company expects shortly to put on the market a new arc motor which, it claims, will govern perfectly and will be constructed on a new principle. Hand regulating arc motors up to ¼ horse power are now being made.

Telegrams in the Cronin Case.

The investigation by the grand jury of the murder of Dr. P. H. Cronin of Chicago served

FIG. 4. OPERATING SEWING MACHINES BY BELDING MOTOR.

to raise a point of interest to telegraph companies. William E. Bell, chief clerk at the Western Union Telegraph company's office, had been summoned to furnish the grand jury with a number of telegrams sent or received by persons charged with complicity in the tragedy. Mr. Bell was representing Superintendent Tubbs, and he refused to produce the telegrams. State's Attorney Longenecker, Foreman Clough, Mr. Bell, and Lawyer Charles J. Holt, representing the Western Union Telegraph company, immediately repaired to Judge Shepard's court room.

"Your Honor," began the state's attorney, "last Friday a subpoena duces tecum was issued on Superintendent Tubbs of the Western Union Telegraph company, directing him to bring before the grand jury copies of all telegrams and cablegrams addressed to or signed by Alexander Sullivan, Alex. Sullivan, A. Sullivan, A. S., or any other name by which Alexander Sullivan might be known. Also such messages in the name of Daniel Coughlin, Dan Coughlin, D. Coughlin, or any name by which Coughlin might be known. Also such messages as were sent by John J. Maroney, W. G. Melville, W. A. Melville, or any assumed name of Maroney. To this subpoena A. D. Wheeler, the company's attorney, made answer that it would take several days to look over the 80,000 odd messages daily handled in the office, and asked until to-day in which to do the work. This was granted. Now Mr. Tubbs, through Mr. Bell, refuses to obey the summons, and will not produce the messages."

[illegible] indeed, we will do all in our power to forward [illegible] transmission of their t[illegible] postmaster would have to give up the mail [illegible] are properly identified and [illegible] protest, and to save our employe[illegible] jail, we will produce such telegrams."

Mr. H[illegible] officials were perfectly willing to have the grand jurors or the foreman go to the office and examine the messages there. "That wont do," said the state's attorney, "and I ask that Bell be directed by the court to answer and produce these messages, or be committed for contempt."

"Very well, my client will go to jail, for we refuse to furnish the messages," said Mr. Holt.

The order was drawn and served upon Mr. Bell, whereupon he delivered the messages to the state's attorney under protest. "We did not want to obstruct the grand jury in any way," said Lawyer Holt, "but we wanted the messages produced, not voluntarily on our part, but upon an order from the court. It was not to antagonize the grand jury, but rather as a protection on the part of the company to the public, and to the company's patrons."

It should be added that in all cases when messages are demanded telegraph companies require an order from court, as the utmost secrecy is required to protect the interests of their patrons. Moreover, it is a criminal offense for a telegraph company or an employe to make public a dispatch without such an order, punishable by a fine of $5000.

Chicago Manual Training School.

The term just closed at the Chicago Manual Training School was marked by the [illegible] tion of a practical electric course on an extensive scale. The pupils who entered this department did so voluntarily, and their progress was the best evidence of the interest which they took in their work. Last week they [illegible] the results of their [illegible] department, and the [illegible] was [illegible]

[illegible] during the last few months [illegible] have given much attention to the construc-

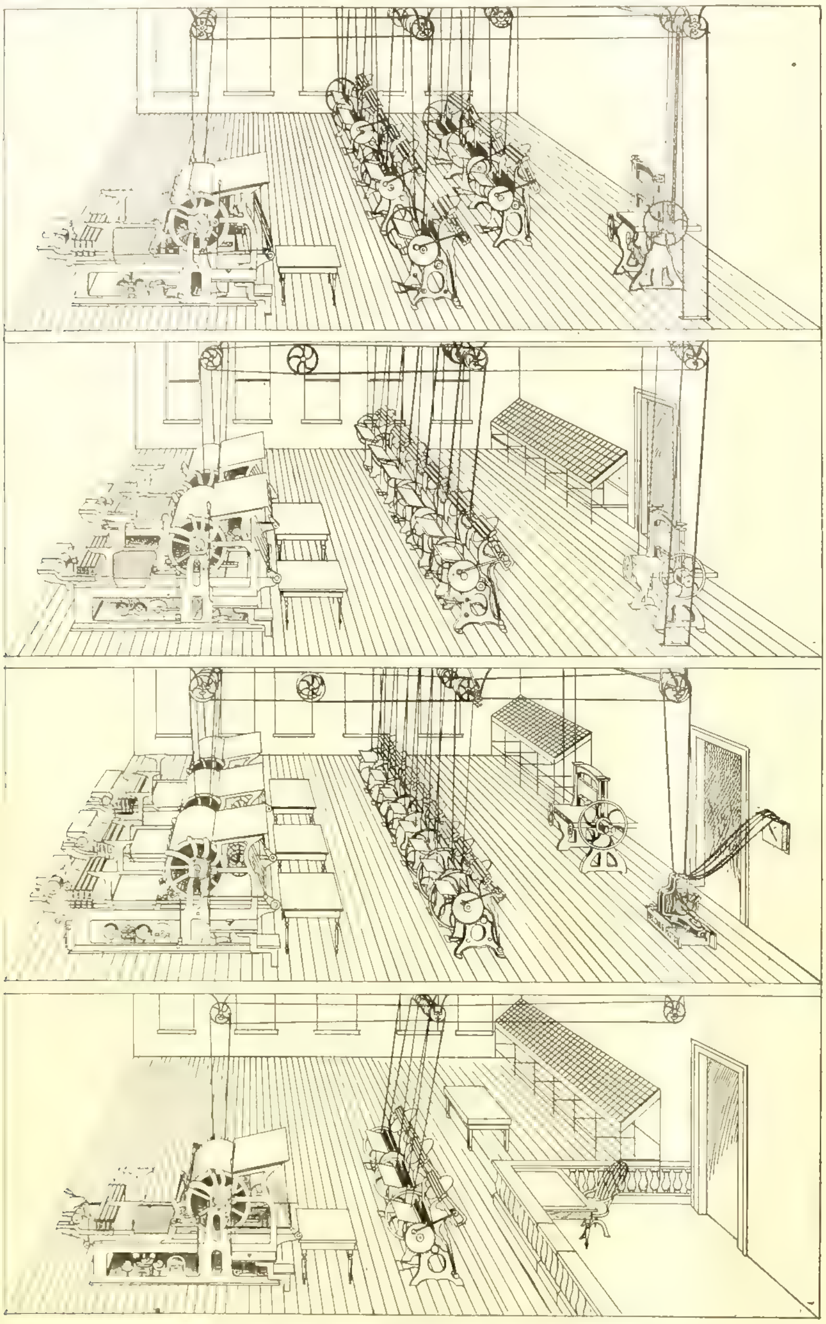


FIG. 5. BELDING MOTOR OPERATING PRINTING PRESSES.

tion of dynamos and motors, and the machines which they turned out proved practical and correct in mechanical detail. They were skillfully constructed and would do credit to older and more experienced mechanics. All kinds of electrical devices were constructed by members of the class, primary batteries, electro-magnets, induction coils, galvanometers, etc. Telegraph lines were established, electric bells were put up, electric gas lighters of different styles [illegible] and many other devices handled.

Many valuable experiments were made in the [illegible] everything was done with a view of gaining practical knowledge of the application of electricity. Next year it is [illegible] will be given [illegible] as it has proved [illegible] are electric [illegible] The [illegible] preparation [illegible] before the [illegible]

[illegible] with the in- [illegible] department was one [illegible]

work they succeeded in, constructing machines after this pattern They are now on exhibition

BENTLEY-KNIGHT ROAD AT ALLEGHENY.

at the [illegible] appearances are [illegible]factory more.

Bentley-Knight Electric Railway System.

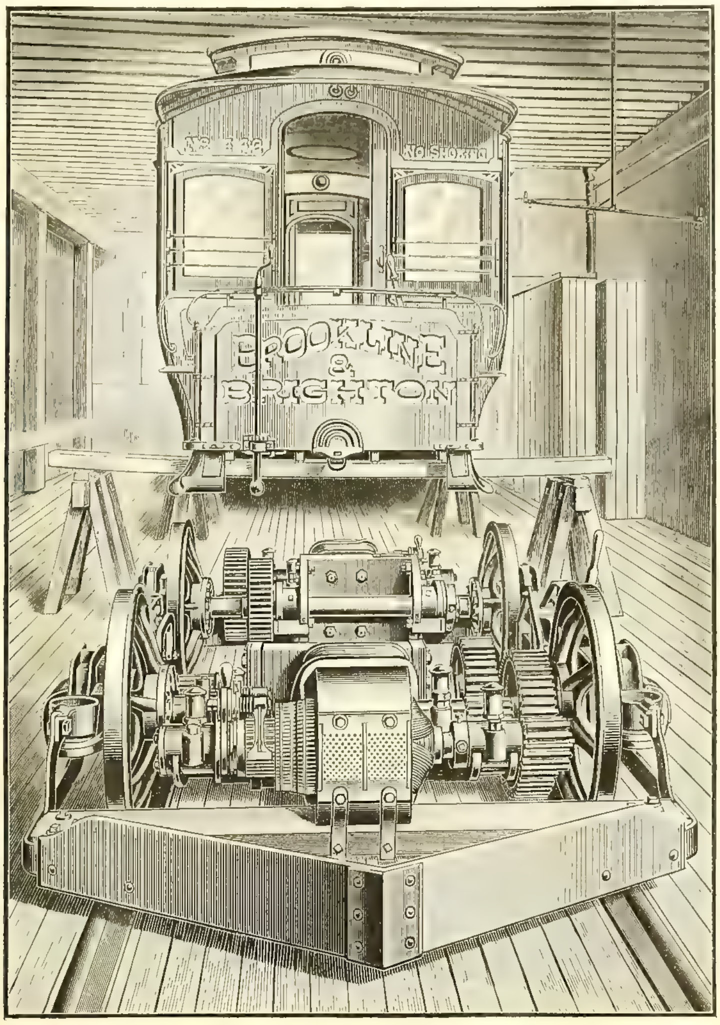
The accompanying cut shows one of the double motor cars now in use upon the Observatory Hill Passenger railway of Allegheny City, Pa. This road is one of the oldest electric railways in the country. The cars have been in continuous service since December, 1887. The equipment was furnished by the Bentley-Knight Electric Railway company, and consists of six double motor cars. The work has constantly been of the heaviest description, the grade climbed being 295 feet in 4,900 feet, while the steepest pitch is 12½ per cent. rise. The road is remarkable from the fact that over two-thirds of its entire length of four miles is on a curve. For one mile the current is conveyed by means of an underground conduit, the remaining three miles by elevated conductors; and each car carries at all times the necessary connections for both underground and overhead conductors.

Figs. 2 and 3 illustrate the double motor trucks supplied to the West End Street Railway company of Boston, by the Bentley-Knight Electric Railway company. Eight trucks are now in use upon the Chestnut Hill, Boylston & Beacon Street route of that railway. The cars equipped with these trucks have been in operation for the past five months, making a regular speed of twelve miles an hour, and have attained a maximum speed in regular service of 19 miles per hour. On Sundays and holidays each of these cars tows two others, and the speed is not sensibly diminished. Each car is equipped for use with under-contact and elevated conductors. For summer use the West End road is now putting on a number of open cars, each equipped with single 20 horse power Bentley-Knight machines; and for excursion work and heavy service has just received from the Bentley-Knight company a 40 horse power machine, which, it is expected, will be upon the road within the coming week. Twelve thousand passengers moved in one day from five tons of coal, and an average cost for fuel of 1¼ cents per car mile, is the record made by the Bentley-Knight cars in Boston to date.

Railroad Telegraphers' Convention.

The third annual convention of the Order of Railway Telegraphers was held at Cleveland, O., last week. The delegates were called to order Wednesday morning, June 19th, by Grand Chief Telegrapher A. D. Thurston. The order has now about 18,000 members, and is composed of railroad operators only. One of the objects of the association is to avoid strikes wherever possible, and as the railroad officials have confidence in the organization, little trouble is experienced in adjusting whatever difficulties may arise without recourse to harsh methods. Each local division has charge of its own funds, regulates its own affairs, makes its own by-laws, regulates the amount of monthly dues and weekly sick benefits, and is responsible to the

grand division only for a per capita tax of 50 cents each year on all members in good standing, and an initiatory tax of 50 cents on all members coming into a division after it is organized. It is also the object of the order to promote temperance among its members, and educate all operators to a sense of the importance of their calling.



BENTLEY-KNIGHT DOUBLE MOTOR TRUCK.

The work of the first session was purely of a routine order, committees were appointed, credentials presented, and the business of the convention mapped out. In the evening public exercises were held in Music Hall. The exercises began with music by the Silver quartet of Cleveland. Judge George B. Solders, who was once an operator himself, represented the mayor of the city, who was obliged to be absent. He proceeded to give a hearty and appropriate address of welcome. He briefly reviewed the history of the telegraph, warmly praised the order and its aims, and gave a chapter from his own experience on telegraph operators' strikes. P. W. McAllister, the past grand chief telegrapher, gave an address of welcome to the members. He urged them to stand by each other, and to enter earnestly upon the very important duties of the convention, which must decide much about the future of the order. The closing address was given by A. D. Thurston, the grand chief telegrapher, who thanked the city and the resident members for their hospitality. In the course of his address he said: "I hope to see the day when the fact that a man's a member of a labor organization shall be a sign that his moral character is all that could be desired."

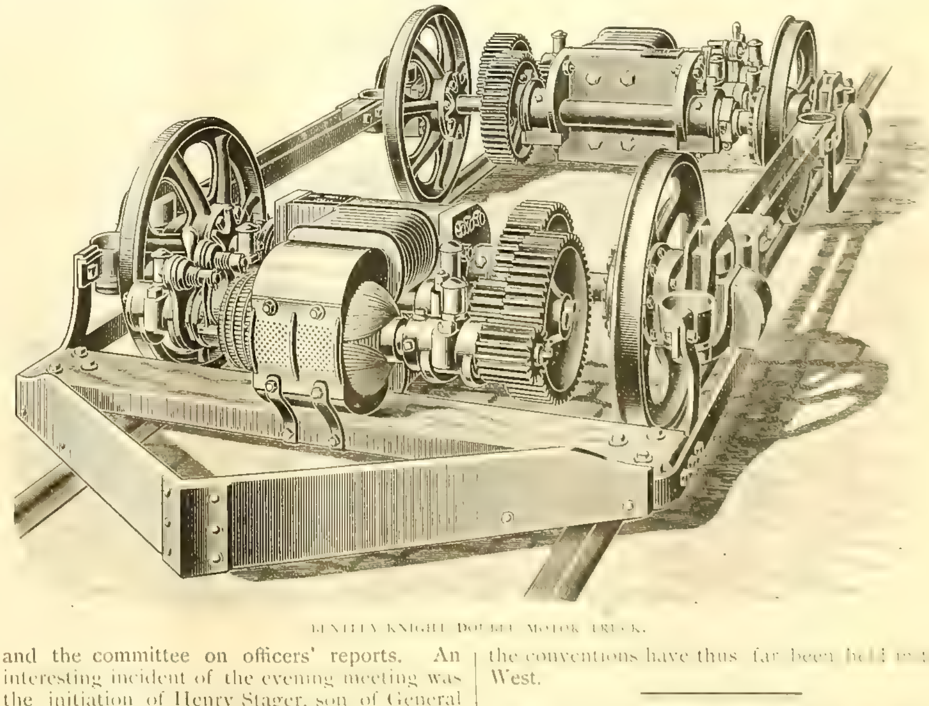
The second day's session was equally interesting, and the attendance was recruited by many additions from distant points. Grand Chief Telegrapher A. D. Thurston submitted his report in the morning, and S. O. Fox, grand secretary and treasurer, occupied the attention of the convention during the afternoon with his reports. The work has been prosecuted both by organizers and by the formation of local divisions. The first year the organizers enrolled 1,408 members; the second year 2,706 members; the third year 2,847 members. During the same period the enrollment by divisions has been as follows: The first year thirty-four divisions with 896 members; second year, fifty-four divisions, with 2,510 members; third year, sixty-one divisions with 2,645 members. The total membership of the society is now, by the official returns, 12,884. These reports were placed in the hands of the finance committee and the committee on officers' reports. An interesting incident of the evening meeting was the initiation of Henry Stager, son of General Anson Stager, late of the Western Union Telegraph company. The grand chief telegrapher and the grand [illegible]

[illegible]

and advancing his salary to $2,000 per annum. He will as heretofore, be [illegible] his salary will be $1,200.

Similar action was taken in reference to the position of grand secretary and treasurer. The financial year was made to close in March instead of May, and the changes in the times of paying dues were made to conform to this amendment. The proposed change in the [illegible] and regalia were not adopted. The amendment to increase the initiation fee in the insurance department was defeated, and in general the convention showed itself a decidedly conservative body. The auditing committee reported that it had examined the reports of the officers, and found them correct. The following officers were elected for the ensuing year: Grand chief telegrapher, A. D. Thurston, of Vinton, Ia.; assistant grand chief telegrapher, H. S. Lambdin, of Columbus, O.; grand secretary and treasurer, S. O. Fox, of Vinton, Ia.; grand senior telegrapher, A. J. Hall, of Cleveland; grand junior telegrapher, James Fisman, of Baltimore, Md.; grand inside sentinel, J. N. Bissell, Galveston, Tex.; grand outside sentinel, W. R. Ford, of Chattanooga, Tenn.; grand executive committee, J. T. Conners, of Albany, N. Y., for three years; T. E. Smith, of New Brunswick, Ont., for three years; F. H. Collins, of Boston, Mass., for two years; grand insurance committee, A. D. Thurston, Vinton, Ia.; W. F. Doran, of Cedar Rapids, Ia. and J. J. McElrath, of Cedar Rapids, Ia.

The fourth and last day of the convention was occupied in the installation of officers and the selection of a place of meeting for the next annual convention. Past grand chief telegrapher, P. W. McAllister, of Minneapolis assisted by N. H. Kirch, of Lexington, conducted the installation. It was finally agreed to hold the next convention in New York city in the third week of June. A number of enterprising Western cities agreed to pay the expenses of the convention and the hotel bills of the delegates for the advantage of having the convention in their towns, but it was deemed advisable to meet in the East, as all of the conventions have thus far been held in the West.



BENTLEY-KNIGHT DOUBLE MOTOR TRUCK.

The erection of an electric light plant is talked of at Lonoke, Ark.

Western Electrician.

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W. H. T[illegible], Manager

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CORRESPONDENCE [illegible] electricity, or any of its practical [illegible] the co-operation of all electric[illegible] earnestly desired. Clear, concise, well written [illegible] especially welcome, and communi[illegible] news items, local newspaper clippings, or any information likely to interest [illegible], will be thankfully [illegible] acknowledged.

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THE representative and correspondent of the WESTERN ELECTRICIAN at the Paris Exposition is Francis W. Parker, box 100, Section Produits Divers, Com. Des. E. U. Exposition Generale, Champ de Mars, Paris, France, and Grand Hotel, Paris.

[illegible] chairman of the Committee on [illegible] State Legislation of the National Electric Light association, calls attention once [illegible] the work of this committee, [illegible] members who have been [illegible] whether they will serve or not. The importance of the work makes it [illegible] reply, that a thorough organization may be perfected.

THE annual exercises at the Chicago Manual [illegible] attention to the [illegible]. That the pupils [illegible] benefit from their training is evident to all who have examined [illegible] men have re[illegible]

conclusion. The object of a technical education is to inculcate in the mind of the beginner the principles underlying his trade, and furnish him therefore the theories which, when put in practice, will enable him to work intelligently, efficiently and economically.

THE fact that Sibley College of Cornell University is devoting an immense amount of attention to electrical engineering is shown by the last number of the *Crank*, the official organ of the institution. In this little magazine appear twenty-one short abstracts of theses prepared by those who have completed their course of study. Of this number twelve treat of electrical topics. Among the subjects are such as "Test of a Storage Battery," "Arc Light Carbons," "Third Brush Regulation," "Electrical Welding," "Study of the Alternating Current Converter." A number of the theses sum up the results of original work.

IN a recent official report it was stated that 1,300 buildings in Philadelphia were supplied with electricity for light or power, and in not one of these had there been any loss by fire for two years. This is an interesting statement, which ought to appeal to underwriters. A Philadelphia inspector comments thus: "This is fairly plain evidence that the electric current, when properly handled, carries no risk with it. It was eight years ago that electric lighting became a commercial success. Ever since that time the insurance men of the city have had a system of inspection in force to secure care in laying the wires and the necessary safeguards against accident. The rules for the government of the electric light companies are not nearly as numerous here as in some cities. It is, of course, impossible to draw up a set of regulations that shall hold good for any number of years. Electricity is too progressive a science for that, and constant modifications and adjustments have to be made."

Probably it is not the intention of the inspector to ascribe the absence of fire to the small number of rules which are in effect, though that conclusion might not unreasonably be drawn from his remark.

A BILL similar to that vetoed by Gov. Fifer of Illinois, granting street car companies the right to substitute electricity or cable systems for horses was passed by the New York legislature recently and has been approved by Gov. Hill. This bill amends the street surface railroad act of 1884 by giving to any street railway company the right to change its motive power to any power other than locomotive steam power, provided such change be approved by the state board of railroad commissioners and the consent of the owners of one-half in value of the property bounded on the railroad be obtained. In case such consent is not obtained, then commissioners appointed by the General Term shall report in favor of such motive power, and the commissioners' report shall be confirmed by the General Term. Some objection was made to this bill on the ground that the consent of the municipal authorities should be required. It is generally conceded that the objection is not sound as it is for the interest of the public that the best motive power should be used by street car companies. It is unquestionably true that property owners would prefer if only for sanitary reasons, to see the substitution of electric power for horses.

Two items of news of especial interest to the telegraph fraternity appear in this issue. One is an outgrowth of the investigation into the celebrated Cronin tragedy. The grand jury ordered the chief clerk of the Chicago office of a telegraph company to produce messages sent and received by persons suspected of complicity in the murder. Representatives of the company [illegible] at first to furnish the telegrams [illegible] on the ground that they had no [illegible] to reveal the [illegible] affairs of those who patronized the [illegible] position, as subse[illegible], was assumed for [illegible] company in a good [illegible] demanded by a court

order. The company wished it to appear that it acted under the hardest compulsion. An order for the commitment of one of the company's employes issued and the latter was temporarily taken into custody. Then the messages were forthcoming and the legal proceedings against the company came to an end. It is stated, however, that the greatly prized dispatches amounted to little after they had been secured with so much strife. Incidentally in the arguments the enormous amount of business transacted by the company's Chicago office was referred to. Eighty thousand messages are daily handled.

The second item alluded to is found in the letter from Kansas City. A telegraph operator instituted a suit to obtain $25,000 from a company because, as he asserts, he was blacklisted by the corporation for joining a telegrapher's protective association. The plaintiff alleged he was unable to secure employment on account of the ban. The presiding judge non-suited the case, holding that the notices sent from one superintentent to another which constituted the black-list, were privileged communications.

SEVERAL writers have recently prophesied with enthusiasm that the electric motor will work a revolution in the industrial world. The fact that power can be distributed in small amounts so economically will make it possible to operate on a paying basis little factories in which the heads of families and their children would be the principal employes. That such a condition would be more desirable than to crowd men, women and children into factories built without regard to sanitary regulations, goes without saying. One of the greatest obstacles to the establishment of small workshops has been unquestionably inability to secure power at slight expense. A recent writer in the daily press speaks of the subject in this way:

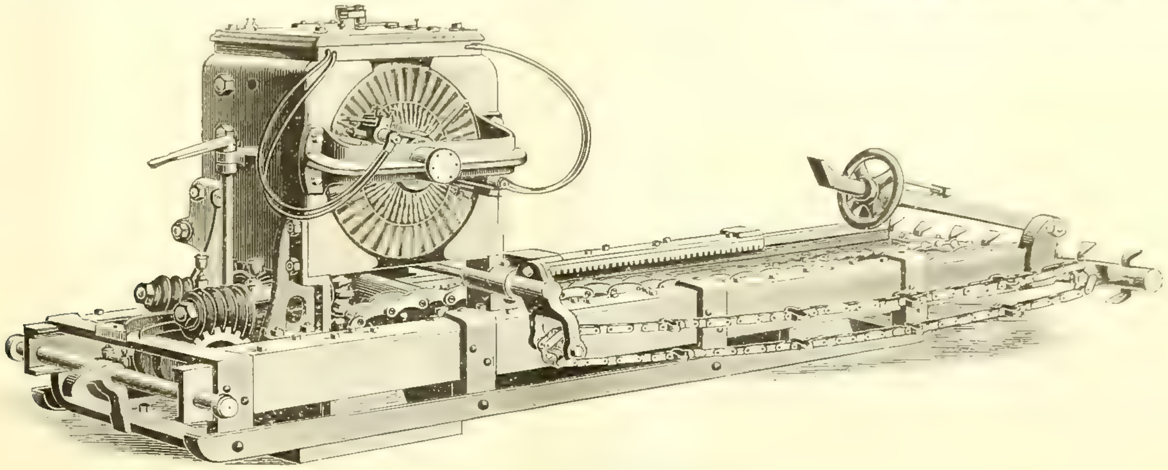
"An expert examination of German industries shows that the small shop is there holding its own and even gaining upon its more impressive competitor [factory system.] If it can achieve equal economy in production, it will drive it altogether from the field. That result is now being promoted by the practical applications of electricity as a motive power. It has been noted recently as a part of the ordinary news of the day that power hitherto running to waste in the shape of waterfalls is everywhere being converted into a merchantable product. It is stated that the factories where dynamos are manufactured are overwhelmed with orders, and that these odds and ends of unused power are being gathered up and transmitted many miles, to points where they can be utilized profitably. This subdivision annuls the necessity of concentrating labor about a given point. With the steam engine the only converter and distributor, all must be done within reach of the shafting which it moves. With the dynamo at work, and power easily transferred anywhere within reasonable reach, thousands of factory operatives will be able to work just as effectively and more economically away from the central area, in smaller workshops, in the suburbs of cities or in villages, frequently in their own homes. This, a few years ago the dream of lovers of Utopia, is rapidly becoming the commonplace fact. Within the next generation we may expect to see a large return to the older system. Industries which, by reason of the imperative necessity of subdivision, or of labor, or by reason of the manipulation of immense masses of matter requiring the combined work of numbers at the same moment of time, will remain concentrated about a fixed center. But industries where the laborer works in any degree of independence will be scattered, and carried on in many small instead of one large factory or workshop. The industrial gain is obvious. But the moral and physical gain, in assisting to abolish the fatal conditions against which the reformers of great cities are forever waging an unequal struggle, will be incalculable."

It is generally conceded that the tendency to concentrate labor is being constantly strengthened, but if the writer's assumption is correct that a reaction has set in, the electric motor may be the means of accomplishing an immense amount of practical good for the laboring class.

Mining Coal by the Use of Electricity.

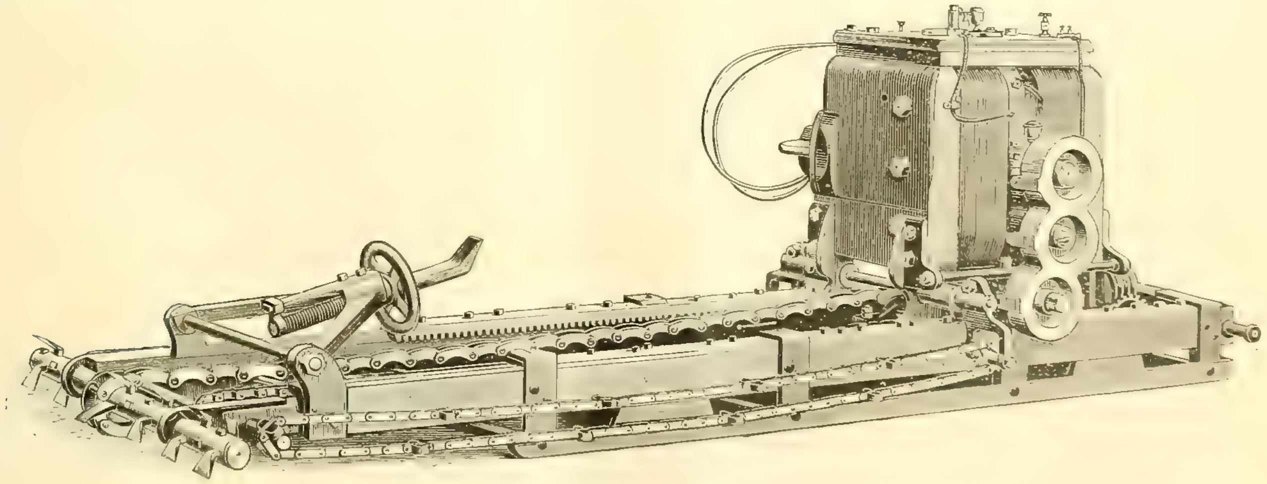
There are so many reasons why electricity is a superior agent for conveying power into a coal mine, there to be used in the operations incident to mining coal, that most of the larger mine operators have been looking forward to the time when electric apparatus could be constructed that would withstand the rough usage to which it must necessarily be subjected.

The fact that power can be transmitted by this means is not sufficient. The apparatus must be practical in the extreme sense of the word, for there is no other place on the face of the earth, or under it for that matter, where an electric motor receives such hard treatment, and where so much is demanded of it. It must remain unaffected by condensation, caused by drafts and changes of temperature; water which constantly drips from the roof of most mines must not injure it; it must be expected tons of falling slate and chunks of coal will fall in and upon it without producing harm; it will be covered with mud and coal dust the first day it is in use, so that its beautiful red coils will know it no more.



MINING COAL BY THE USE OF ELECTRICITY.

The Jeffrey Manufacturing company of Columbus, O., has been for a number of years manufacturing the Legg coal mining machine, which heretofore has been operated by compressed air. The company has been untiring in its efforts for the past two years to substitute electricity, and has been assisted by several of the most able electrical and mechanical experts in this country. Several of the larger motor companies have made efforts in this direction. A great deal of money was expended in experiments. Finally, the company secured the valuable services of Foree Bain of Chicago. Mr. Bain went into the mines and for a time became a practical miner in order to study the conditions to be met, and the difficulties to be overcome.



MINING COAL BY THE USE OF ELECTRICITY.

The illustration shows the electrical mining machine, as perfected by Mr. Bain. The motor occupies a space about 20 inches square; it is very solidly and substantially built. The characteristics of the details do not show in the engraving. At present the inventor is not ready to describe them. The motor requires 22 [illegible] and a current of 60 amperes when working at its maximum capacity, and develops 15 mechanical horse power.

The machine has been in practical operation every day at the mines of the Shawnee & Iron Point Coal company, Shawnee, O., since the first of May. It only requires three and one-quarter minutes to make a cut of five and one-half feet deep and three feet face. The cuts are made and the cutter bar is withdrawn within four minutes, and the machine is moved ready for another cut in less than ten minutes. It requires no effort on the part of the attendant while the machine is at work. At this rate 6 cuts per hour or 60 cuts per day of 10 hours can be easily made, and the machine will undercut 200 tons of coal. This is the capacity of the first machine which is now in operation. It is the opinion of those able to judge, that under favorable conditions, 300 tons of coal can be undercut per day. Mr. Bain has also installed in this mine an electric hauling plant of his construction. The gathering motor is only 8 horse power, and hauls from 6 to 7 loaded cars of 2½ tons. The mining machine takes current from the same circuit, as do also quite a number of incandescent lamps. Mr. Bain is now constructing three additional mining machine motors and a 20 horse power locomotive for the Jeffrey Manufacturing company, to be used in this mine.

The Paris Exhibition.

The electrical display at the Paris exhibition surpasses by far the anticipations of the most sanguine, and even those who are most interested in its development are astonished at the progress which it has made in every country as evidenced by the representation at the Exposition. Paris never before saw such a display of electric lights. Since May 19th the electric light plant at Machinery hall has been in operation. The central stand is now practically complete. It is surmounted by a lighthouse lamp [illegible] combination [illegible] machine, combined mixer and elevator, loaf sugar breaker, and air compressor. There are over 600 exhibitors in the electrical department. The lighting of the boulevard between the Place de l'Opera and the Place de la Concorde has been undertaken by the Thomson-Houston company, 50 2,000 candle power arc lamps being used. The Thomson-Houston International Electric company is running an 80-horse power dynamo by which a 45 horse power motor will be run in the American Section of the Agricultural Annex to supply light and power. This company will also light the American Section, and will run a 35 arc lamp machine, a 500 light alternating transformer machine, and 300 light alternating compensating system.

Further interest will center on the two systems of electric 10 ton cranes, now working, both as to their mechanical and electrical arrangements. The first to be set to work is operated by a Gramme motor and dynamo, the latter being run by a Westinghouse engine in a shed some distance from the crane.

Opening of the New York Telegraph Club.

The new rooms of the New York Telegraph [illegible] Church street, near [illegible], were [illegible] of June 15th, the occasion being the [illegible] quarters which have been elegantly [illegible] nished. Although it has been organized [illegible] the club has already shown its usefulness [illegible] suitable pleasant and convenient resort [illegible]

[illegible] the [illegible] telegraph offices of the metropolis, where most of them are employed. Several of the old-time telegraphers had expressed their good wishes by contributing portraits and bric-a-brac for the adornment of the rooms. A library of scientific and light literature, a piano and billiard table offer facilities for amusement, instruc- [illegible] the ladies of "195 Broadway" showed their approval of the organization by sending as a gift a silver ice pitcher and goblets. The exercises of the evening opened with an overture on the piano by Master Harry Phillips, followed by the presentation of the keys of the rooms by the chairman of the governing committee to President George E. Holbrook, who accepted them with appropriate remarks. An address was delivered by Jas. D. Keid in his most happy vein. Miss Bulger followed with a song, and Ed Delaney with a recitation, after which D. W. McAneeny sang a solo. W. J. Dealy, manager of the Western Union office, made an exceedingly appropriate address. An intermission was then announced, during which the ladies, who formed a good third of the audience, were permitted to monopolize the billiard and card rooms, where refresehments were served under the direction of Martin Dunn, head waiter of the Western Union restaurant. After the gentlemen had taken their turn at the good things, Miss Susie Stephenson sang a soprano solo. W. L. Ives made a ringing address. After a second solo by Mr. McAneeny, Conrad Myer, second vice-president, made the closing remarks of the exercises, which were of the most interesting character throughout. The member- [illegible] has reached 200, and the organization gives promise of a career of usefulness.

Brooklyn Street Railway, Cleveland, O.

The Brooklyn Street railway at Cleveland, O., using the Thomson-Houston system, has been [illegible] a month long enough, the representatives of the railway state, to prove [illegible] the excellent points its [illegible] This line is one of the [illegible] undertakings in [illegible] in the country, com- [illegible] grades, and twenty- [illegible] The installation presented many [illegible] but they were [illegible] railway company. [illegible] and on [illegible] one and one- [illegible] engines and [illegible] position, [illegible]

[illegible] length of the line was [illegible] half miles, and [illegible] The road [illegible] miles of double [illegible]

The road crosses the Central viaduct over the Cuyahoga river, which is 2,840 feet long and 102 feet high, and has a 237-foot draw. In constructing this line wooden poles were used for three miles, and iron poles for one and one-fourth miles. Those on the viaduct are said to be the best yet used in electric railway work.

CLEVELAND ELECTRIC RAILWAY.

The twenty cars were built by the John Stephenson company. Ten are equipped with two 15-horse power Thomson-Houston motors, and the remainder are tow cars. All are finished in the best possible manner.

To each motor car is attached the T. L. Johnson patented brake [illegible] enables the motorman to control at once a three-car strain with perfect ease [illegible] disagreeable jar or [illegible]

The brake [illegible] a shaft that is constantly kept in motion by a sprocket chain from one of the axles [illegible] On this shaft there are a tight disk and a loose drum, and to the latter is attached a chain. The operating device on the platform consists of a lever, by which the tight disk is brought into contact with the loose drum, forcing it to rotate, and thus winding up the chain which applies the brake to either one or two cars, as desired.

The car and inspection house is provided with pits, so that the cars can be cleaned and inspected without necessitating the loss of a trip. The power house is situated near the track, and is equipped with two 150 horse power boilers, built by the Variety Iron Works of Cleveland, and two 125-horse power Ball engines. The electrical plant consists of two 80-horse power Thomson-Houston railway generators, and a switch-board with necessary appliances. For eight days' working with ten motor cars, each towing one, and sometimes two cars, and carrying on an average 10,000 passengers daily, utilizing one boiler, two engines, and both generators part of the time, the coal consumption has been 500 pounds of slack coal per hour, at a cost of $1.20 per ton. This line is giving perfect satisfaction to the public, and the railroad company intends to equip the entire line with this system as soon as possible, a purpose which indicates that it is perfectly satisfied with what has already been done.

Convention of Rapid Tiansit Street Car Men.

Some time ago Dr. W. L. Allen, president of the Davenport Central Electric Railway company, called a meeting of the officers and managers of all the seventy-five or eighty electric street railways in the United States. From the replies received urging pressing business he was inclined to believe that he would succeed in getting together perhaps a sufficient number to act as president and secretary of the meeting. On June 20th, however, he found that a very respectable assemblage of gentlemen was on the ground. The following gentlemen were present: T. J. Evans, president of the Omaha & Council Bluffs Electric Railway & Bridge company; H. E. Teachout, president of the Des Moines Electric Railway company; O. J. Chapman, superintendent of the Des Moines Electric Railway company; J. L. Barclay, Western agent for the Sprague Electric Railway & Motor company; Chas. H Cone, agent of the Electrical Supply company of Kansas City, Mo.; Messrs. Watson & Ward, who are operating a road in Sterling, Ill.; F. T. Blunck of the Seattle, Wash. Ter., electric railway; C. R. Giddings, general

CLEVELAND ELECTRIC RAILWAY.

manager of the Sioux City Corliss Engine company; Walter Chambers of the Davenport Central railway; John W. Howard, superintendent of the Davenport Central railway; Wm Bowen, general manager of the Hawkeye Electric Manufacturing company; Dr. W. L. Allen, president of the Davenport Central Electric Railway company.

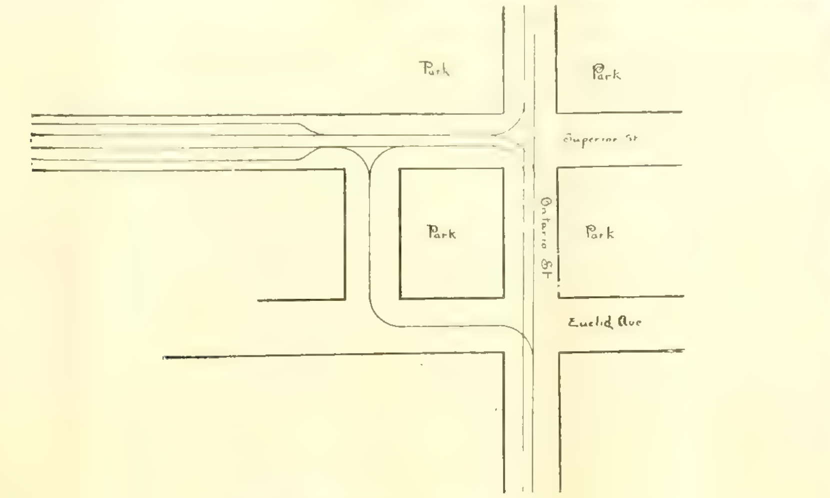
A temporary organization was effected at the parlors of the Business Men's Association, Mr. Evans presiding, Dr. Allen acting as secretary. The day was passed in inspecting the plant of the Central Electric road, and inspecting the extensive shops of the Hawkeye Electric Manufacturing company. The gentlemen dined at the Piute club. On June 21st the inside session was resumed. As this was the first convention of this sort ever held, it took some little time to organize the work. The discussion was very largely informal, but the following assignments of topics were made and accepted by the gentlemen named: "Legislation," Teachout, Ward and Geyer; "Track," Evans and Moore; "Car Equipment," Chapman and Barclay; "Station Equipment," Chambers and Barclay; "Line Equipment," Barclay and Howard; "Reduced Rates for the Encouragement of Patronage," Howard and Chapman; "Free Transportation to City Officials and Others," Evans and Watson; "Comparison of the Expense of Operating by the Three Kinds of Power, Viz.: Steam, Animal and Electric," Allen and Chapman.

At half-past 4 o'clock the convention adjourned for the day, and the members became the guests of the Hawkeye Electric Manufacturing company. A drive about the city was thoroughly enjoyed.

The assemblage before adjournment was organized into a permanent organization, with T. J. Evans of Omaha president for the coming year, and Dr. W. L. Allen of Davenport secretary. It was decided to hold the next meeting in September at Minneapolis. The members adjourned, feeling that the organization would be a benefit, not only to each individual, but would become a force to prevent unfavorable legislation. It is safe to say that the association thus formed will be, in a few years, a strong organization, and will have representatives from all the States and Canada. All members in leaving expressed themselves as highly pleased with courtesies shown them by the people of Davenport, and they accord to Davenport enterprise the honor of giving the convention its birth.

Following is an abstract of a paper read by Dr. Allen of the Davenport Central Street railway:

"During the past year the advance of electricity as motive power for street railways has been so rapid that we can scarcely keep track of it. As late as February, 1888, they were experimenting with trolley wheels of the crudest form. Copper commutators were used which, with the brushes then in use, scarcely lasted a week in some instances. It was thought doubtful if a car could be run without a conductor who could at least be employed in replacing the trolley. Our road here has perhaps experienced as much of the experimental changes as any road in the West. Of all changes made in the past year by far the most important to us has been the abandonment of copper or other hard metal brushes, and the substitution therefor of carbon or graphite. In ten months we have worn out [illegible] commutators with [illegible] four regular cars. These cars have been [illegible] four miles a day over the main line where we [illegible] curves and [illegible] of 7¼ grade [illegible] In [illegible] we have used up 1,000 copper [illegible] cost us forty cents each. This is [illegible] per month. Moreover we have been [illegible] car each week in order to have commutators [illegible] etc., and have kept one engineer's time fully [illegible] ing down motor [illegible], so that [illegible] day [illegible] brush might be adjusted. As regards gear, we find that it becomes worn and is then noisy, and we hope that [illegible] rawhide may help overcome that; at present we must expect to renew our gear every ten or twelve months; we have broken two outside gear, four intermediate and six pinions; in other words, with four cars running we have broken less than half our gear in ten months, but the whole ought to be replaced on account of noise."



CLEVELAND ELECTRIC RAILWAY.

CORRESPONDENCE.

New York Notes.

NEW YORK, June 22.—The controversy over the relative effectiveness of the alternating and continuous currents as death dealing agents has not been ended by the selection of the apparatus for the execution of murderers in this state; on the contrary, it seems to have served to increase the interest of electrical experts and at present the advocates of both systems are engaged in a war of words. The alternating current men say that their system is misrepresented by the continuous current people, who enlarge upon its death-dealing qualities, and in support of their statements present affidavits from men who have sustained severe shocks not only without fatal results, but without experiencing injurious effect. The fact that the constitutionality of the law is questioned keeps the subject open for discussion. Harold P. Brown, who succeeded in disposing of an outfit to the state, is the subject of many uncomplimentary remarks on account of his part in the deal. Prominent electricians throughout the country take issue with him.

A prominent electrical engineer is quoted as saying: "I have been unable to find an electrician of standing who does not boldly assert that Mr. Brown's alleged tests were unfair, or who considers him competent to advise the state on this subject or to conduct an execution. Mr. Brown said one of his dogs measured 200,000 ohms resistance, and although he tried both the continuous and alternating currents on it for a total of ninety five seconds, it was unhurt. He killed only one dog instantly, and that was with a continuous current; yet he recommends an alternating current as the surest means to an instantaneous and painless death. When these and other minor facts are considered, the danger of intrusting the execution of Kemm'er to Mr. Brown's supervision is apparent. Human beings will probably range as high as to resistance as dogs, and Mr. Brown has not made any recommendation as to what shall be done with Kemmler should his resistance measure 200,000 ohms." The controversy has assumed a decidedly personal character, to say the least, and at present there is a promising outlook for a racy exchange of opinions, which will prove highly interesting during the usually dull summer months.

The latest developments in the electric sugar swindle is the suit which will be brought by R. Burnham Moffat, the receiver of the Electric Sugar Refining company, against the swindlers for a cancellation of the stock held by them, and for the recovery of money obtained by them from the corporation, or expended by it upon their fraudulent misrepresentations. The conviction of Howard ended a most interesting trial. The "Parson," as he is called, was thus dispatched by Recorder Smythe: "A more outrageous fraud has never been brought to my notice than the fraud, or series of frauds, which was perpetrated by you and your [illegible] switch-board.

[illegible] brought responses which were all rejected as being b[illegible] the [illegible] were opened [illegible] er consideration [illegible] The United States [illegible] $4[illegible] and the Electric Accumulator company's [illegible]

The Gas commission [illegible] only receive bids from the electric light companies which have plants within the districts to be lighted, but also from all others located in any part of [illegible]. The new bids will be opened July 26.

The following are the newly-elected directors of the United States Illuminating company: Geo. Westinghouse, Jr., Caleb H. Jackson, Paul D. Crovath, George W. Hebard, James Stokes, Duncan D. Parmly, Joseph W. Hartley.

W. H. [illegible]

Kansas City, Mo.

KANSAS CITY, June 22.—The [illegible] a telegraph operator against the Chicago, Rock Island & Pacific Railroad company to obtain $25,000 damages for alleged blacklisting came to trial last week. Edward L. Randall, the petitioner, is an expert operator, and until July, 1886, had been employed by the Rock Island road at Davenport, Ia. In June, 1886, he became identified with a movement among railroad telegraph operators to organize a protective society. The convention for the formation of the society was called for June 9th, of that year, at Cedar Rapids. A number of operators applied for leave of absence to attend the meeting, but were refused, the railroads issuing an order that no operator be granted a leave of absence for ten days. At the convention Randall was elected assistant grand chief. A few days after this he was discharged from the employment of the company, it is alleged his name was sent as a discharged employe to all other telegraph offices in the country. This was done, it is claimed, by placing his name on the circular issued by the superintendents of the various roads, headed simply, "The following names have been reported." The fact that his name had been placed on this circular debarred him, it is said, from obtaining employment in any telegraph office in the country. About a year ago he obtained work at the Union depot in this city, but when it was discovered that he was blacklisted Randall says he was promptly discharged. [illegible] in his opening address to the jury, detailed all the circumstances of the case, and declared that in consequence of the refusal of the railroad company to remove Randall's name from the blacklist and his inability to get work thereby, he had been reduced to absolute poverty, his family had suffered actual privation, his name had been heralded broadcast over the country as a discharged and unworthy employe, he had been classed with thieves and drunkards, and the $25,000 asked for was none too much to compensate for the injuries he has suffered.

At this point the defense objected to the [illegible] of evidence, because the action, as they claimed, was for injury done to character, and it was the words [illegible] and even if they did injure him, he had not a right of action. In their opinion the petition was defective in that it was not brought as a libel. The defense argued the case for about three hours, and then [illegible] presented his views. He argued that this was [illegible] for libel. If the railroad committed a wrong [illegible] the plaintiff, the law gives him a remedy [illegible] be turned out of court because he [illegible] his action. The [illegible] prevented him from [illegible] bread to eat. The circular [illegible] carried a secret import [illegible] person [illegible] company, and this [illegible] and not of slander. A [illegible] be privileged must be asked [illegible] If a servant has done no wrong [illegible] that calls upon his employers to [illegible]

[illegible] was a lawful and [illegible] Wofford in closing, [illegible] to the courts [illegible]

[illegible] the petition in which the railroad claimed that the words were not libel- [illegible] were not actionable [illegible] taken by Col. Wofford [illegible] and that he had [illegible] it, was correct.

[illegible] Randall, the plaintiff, was the first witness placed on the stand. He detailed his early experience in [illegible] he had devoted the best years of his life to that business, and that he was [illegible] vocation. He told of [illegible] among operators in 1886 to organize a protective fraternity, and of the violent antipathy the railroad had to any one connected with the movement. He swore positively that he was discharged simply because of his connection with the society and detailed how he had endeavored to obtain employment, but had failed to get what he was in search of because his name was on the [illegible].

Col. Wofford took Randall off the stand before he finished his testimony, and the defense called A. R. Swift, the superintendent of the telegraph lines of the Rock Island railway. The witness testified in reference to the organization formed by the various superintendents through the country. The organization was formed for mutual protection against bad and incompetent men. The circulars were sent over the country at stated intervals, and gave information in reference to men discharged, and the reasons for their removal.

Judge Gibson, of the Circuit court, on the following day non-suited the plaintiff on the ground that the discharged list was a privileged communication, which it had the right to send to officers of the telegraph service, whose province it was to supervise the employment of operators and pass upon their fitness.

The Elevated Railway company has decided to employ electricity, as a motive power on one branch of the system and the electric light line will be from the Union depot to Riverview Station and then to the end of the Riverview [illegible] at present a cable.

This change will be hailed with satisfaction by the residents of West Ninth street, who have always complained of the noise and smoke of the dummy engine. The determination to build this line has been brought about by the unsatisfactory working of the Riverview cable line. The company has thought seriously of using [illegible] engines, and at one time intended to petition the city council of Kansas City, Kan., to allow it to make the change. The property owners along the line did not view the project with favor and so matters stood.

A short time ago the proprietors of an electrical system [illegible] made a proposition to the "L" people and offered to equip the road with their apparatus and wait for the remuneration until some time in the future. The [illegible] has the proposition under consideration and will [illegible] work on the erection of [illegible] will soon be commenced, it [illegible] a year before the road will be in running [illegible] will be abandoned on [illegible] will be used. The de- [illegible] "L" road people to make the Union [illegible] branch and the Riverview cable line one, indicates [illegible] line of the Chelsea [illegible] street line connecting with Armourdale, which will be constructed as [illegible] It is also [illegible] the right to [illegible] end of the [illegible] of the line [illegible] for a new street rail- [illegible]

[illegible] city. Such a change [illegible] decided upon, but is under serious consideration.

John R. Mulvane, president of the telephone company has explained to the telephone committee of the Commercial Club that the reason the company announced in its rate circular that the [illegible] were in accordance with the Commercial club's recommendations was because the company believed such to be the fact. It is understood that the company's rate [illegible] changed to $60 for residence telephones inside the three-quarters of a mile limit and $64 for those outside that limit, and yet inside the city limits. P.

Omaha, Neb.

OMAHA, June 22.—The Omaha Thomson Houston Electric Light company, after a brave struggle, has at last reached that satisfactory stage where it is able to declare a dividend. The affairs of the company are in most excellent shape, and it is now proposed to greatly enlarge and improve the plant. With this object in view, the company has purchased ground between Jackson and Leavenworth streets with a frontage of over 300 feet on Fifth street, on which it proposes to erect a large and substantial power house, in which will be placed the latest improved machinery. It is proposed to expend $150,000, which, with the amount already expended, will make an investment of $225,000. The company intends to furnish incandescent lights twenty-four hours a day, and is already making contract to wire several large buildings.

The Electric Motor company and the consolidated street railway lines have practically entered into an agreement to stop all extension of their lines unless the ordinance compelling them to pay the original cost of paving on streets upon which they run, and also to replace the same as good as new, is repealed.

The decision affects all the proposed lines for which the companies have taken out permits, including those to South Omaha. While the agreement virtually has this effect, it has not yet assumed definite shape. The companies may consolidate their business altogether or they may simply enter into articles of agreement to build no further.

Dr. Mercer, of the motor company, said: "Street car line extension is about over in Omaha for ten years to come unless that oppressive ordinance is repealed. The burden imposed is such that it would not pay to build new lines on paved streets. Under the ordinance it would cost us $40,000 to extend our lines to the south part of the city to pay for paving alone. If we could simply replace the paving it would only cost us $10,000." R.

St. Louis, Mo.

ST. LOUIS, June 22.—It is proposed to perpetuate the universal electrical exhibition, which, under the management of F. H. Whipple, will be one of the features of the exposition next fall, and to make it a permanent institution in St. Louis. Speaking more correctly, this exhibition will be held every year, but in 1890 will not be confined to a mere display. Medals will be awarded to inventors, and probably to exhibitors, and the bestowal of these tokens of approval will rest with a board of scientific men. The board will be composed partly of Americans, and partly of Europeans.

After a vexatious delay of considerable duration, which gave rise to a considerable amount of sharp criticism and unfavorable comment, notice was filed last week in the office of the Recorder of the incorporation of the Municipal Electric Lighting & Power company with a capital stock of $750,000 paid in. A meeting of the new company was held, at which the following officers were elected: President, Julius S. Walsh; vice-president, Charles Sutter; treasurer, John M. [illegible] secretary, Mortimer F. Taylor, and assistant secretary, [illegible]. The directors are Julius S. Walsh, Chas. Sutter, [illegible] Von Phul, John M. [illegible], M. F. Taylor, [illegible] Hill, and Brainard [illegible]. Mr. Sutter states that things are now in a [illegible] conclusion. "I presume," he said, "that [illegible] of the new company [illegible] attack which have [illegible] opponents will be [illegible] are in earnest. We [illegible] arrangements, and are [illegible] We have ordered [illegible] arrived in the [illegible] power [illegible] Hamilton-Corliss [illegible] bold from them [illegible] delivery to us on or [illegible] Wire company, of [illegible] the best quantity of [illegible] bond compelling them to forward it to us at the rate of fifty miles a week. [illegible] Bros. of this city are already at work upon the boilers, and the dynamos are being made in Indianapolis. You may say that the plant will be dully installed and in full working order in time to carry out the terms of the contract." The approximate expenditure will be between $600,000 and $650,000. There will be in addition to the capital stock of $750,000, a bond issue of probably $500,000, to bear 6 per cent. interest. The amount has not yet been definitely determined, though Mr. Sutter said enough had already been placed in the East to carry out the work. The contracts do not begin until January 1st, and it is expected the company will begin furnishing commercial lights by October 1st. The plant to be erected will have a horse power of 6,000. The building, however, will be of sufficient dimensions to put in machinery for 9,000 horse power. It will also accommodate the machinery necessary for incandescent lighting, which will be added as soon as the arc light plant is completed, both to be in working order by January 1st. Of the 6,000 lights, with which the company will start, the city contracts will take 2,260. "We are now making contracts for private lamps," said Mr. Sutter, "at $10 per month, the lamps burning from dark to 1 A. M. Our incandescent lights will be placed at a rate to give cheaper light than can be had from $1 gas. In large buildings, residence or commercial, we will put in meters, while in smaller buildings and residences the charge will probably be on the basis of one cent per hour per light."

In reference to the stringing of the wires and the laying of the conduit of the Dorsett Conduit company, Mr. Sutter said the wires would be strung in the outlying districts first. George Le Vin, engineer of the Chicago system, is now in the city consulting with President Flad of the Board of Public Improvements, and a permit to go ahead with the work is expected in a few days. If the conduit is not completed by that time, then the wires will be strung on poles down town. C.

St. Joseph, Mo.

ST. JOSEPH, June 22.—The Wyatt Park company is now preparing to make extensive improvements with all possible dispatch. It has just let the contract for an addition to the power house. The addition will be erected on the north side of the power house, and will contain the new machinery necessary for the new lines. The company has contracted for two new 18x36 Corliss engines, with a capacity of 150 horse power. They are now being manufactured by the Sioux City Engine works. Three new dynamos have been purchased, and will be placed in position as soon as the addition is completed. The contract for this work has already been let, and, it is stipulated, must be completed by the first of August. A line of road will be built at once to run from the power house to the Steel Car Works. The contracts have already been let, and work will be commenced at once and pushed to completion with all possible speed. The line will be a little over a quarter of a mile in length, and will be double-tracked and ballasted to withstand the enormous traffic expected during the coming exposition. The company will not waste any time in getting the additions made, and calculate to be ready for business at the proper time. R.

Louisville, Ky.

LOUISVILLE, June 22.—Last week the initial run was made on the Green street electric railway, which has since been operating successfully. The first cars were filled with city officials, capitalists and newspaper men, and the route was lined with spectators for the extent of five miles.

The exchange of the Ohio Valley Telephone company is situated on Green street, and the telephone service, it is claimed, has been impaired by the electric railway circuits.

Arrangements are being made to place the fire department's wires underground.

The Louisville Electric Light company has installed two Westinghouse alternating machines of 750-light capacity each. A third machine is to be installed.

Mr. Littell, superintendent of the city railway, is operating an electric street railway in Cincinnati.

John E. Watson of Louisville, has invented and secured a patent on a relay apparatus for telegraph lines. A company has been organized to introduce it.

The Citizens' Electric Light & Power company has been incorporated at Lexington, with an authorized capital of $100,000. The incorporators are J. D. Yarington, Louis Strau[illegible], J. L. Keller and G. A. DeLong, of Lexington; Dr. Norwood of Fayette county, J. D. Simpson and Smith P. Kerr of Winchester, and J. H. Meade of Cincinnati. The Thomson Houston system will be installed, and day and night circuits will be established for furnishing light and power. A.

THE ELECTRIC LIGHT.

Benton Harbor and St. Joseph, Mich., will be lighted by electricity at once.

The Thomson-Houston Electric company will introduce an incandescent plant at Nashville, Tenn.

The dynamos used in the tower at Hell Gate have been purchased by the Calais, Me., Electric Light company, and will be transferred to its power station.

The Goldsboro, N. C., Electric Light & Power company has been incorporated by O. H. Foster, C. A. Ballow and B. S. Jennan. The plant is now in course of construction.

The Greencastle, Ind., city council has concluded to light the principal streets with arc lights, and to continue gas lights on the remaining streets. The electric light company will supply fourteen lights at $72 each per annum.

By a mis-print in the WESTERN ELECTRICIAN, the bids for the electric light plant for the Michigan Soldiers' Home were advertised to be opened on the 30th instead of the 20th of June. It has therefore been thought best to issue a new advertisement, which will be found in the advertising columns.

The Hotel Harrington at Carthage, Mo., has introduced incandescent electric lights, 126 16-candle power lamps being distributed through the house. The Carthage Electric Light company introduced the Detroit Storage batteries of the Woodward Electrical company, and they are giving satisfaction.

The Keystone Construction company of Pittsburg, Pa., through E. E. Keller, manager Chicago office, has sold a 1,000 light Westinghouse plant in Sterling, Ill. The plant will be run by water and steam. Two hundred 25 candle power lamps will be used for street lighting, and will be hung over the middle of the street from a special fixture designed by the Keystone company.

The city council of Denison, Tex., has granted a franchise to the Thomson-Houston Electric Light & Power company to operate an arc and incandescent and electric power plant in that city. The ordinance granting the franchise provides that the work shall be begun by the company within sixty days, and that the plant shall be in operation within six months. The franchise was granted for a period of thirty years.

Several English railroad companies are experimenting with electric lighting of trains. Substantially the same system as has for some time been in use in this country will be introduced. Each coach is provided with a secondary battery, all the batteries being charged from a dynamo carried on the train. By thus subdividing the battery a train may be broken, or portions of it sent on branch lines, without interfering with the lighting power in each individual coach. The whole of the train is arranged on the parallel system, the connections between the main cables being made by special couplings, which enable each vehicle to be attached in either direction without interfering with the continuity of the circuit.

In a most interesting book upon "The Railways of England," by W. M. Acworth, it is mentioned in a foot note that the engineer of the Paris, Lyons, & Mediterranean railway has stated that he has economized £4,000 a year by connecting the taps of the gas jets with the night caps of the carriage lamps, so that when the cap is drawn over the glass the gas is turned down to a mere glimmer. This is a large sum, and it is hardly likely that so much would be saved by turning down the electric light (it should not be turned quite out), but means for doing so on the night trains should not be omitted, both on this score and on that of comfort to the eyes of sleepers, says an English paper. In the same book it is mentioned that the comparative cost of oil, gas, and electricity is as 1 : 1¼ : 1⅓.

The Thomson-Houston Electric company reports the following sales: Kingston, N. Y., 1,300 incandescent; Austin, Me., 30 arc; Santa Cruz, Cal., 300 incandescent; Reedsburg, Wis., 300 incandescent; Andover, Mass., 50 arc, 600 incandescent; Fremont, O., 600 incandescent; Chelsea, Mass., 600 incandescent; Hoosick Falls, N. Y., 600 incandescent; Kansas City, Mo., 400 incandescent; St. Paul, Minn., 100 arc, 300 incandescent; Mitchell, Dak., 30 arc; T. Norcross, Janesville, Wis., 45 arc; Hunter Electric company, Belle Plaine, Ia., 12 arc and 600 incandescent; A. C. Houston, Chicago, 25 arc; Excelsior Springs, Mo., Electric company, 300 incandescent; Northwestern Cold Storage & Ice company, Portland, Ore., 80 incandescent; George E. L. Keith, Campello, Mass., 650 incandescent; Ottawa House, Portland, Me., 380 incandescent; International Telephone, District and Construction company, Baltimore, Md., 1,300 incandescent.

THE ELECTRIC MOTOR.

The company for constructing the electric railway between Denison and Sherman, Tex., has been organized with a capital stock of $200,000.

The Sprague Electric Railway & Motor company of New York has filed a certificate at Albany, N. Y., for an increase of its capital stock from $1,000,000 to $1,600,000, of which $400,000 is to be preferred.

The common council of Muncie, Ind., has allowed the request of the constructors of the new electric street rail road to use a "T" rail. A franchise was granted with the amendment, and work has begun. The parties interested are from Vermont and Cincinnati. The road will be slightly over eight miles in length.

The city council of Richhill, Mo., has passed an ordinance granting a 20 year franchise to the Richhill Electric Railway & Light company. The company agrees to construct and operate an electric railroad from the city to the mines, a distance of five miles, and also furnish the city with electric light. The city guarantees a 5 per cent. dividend [illegible] amount [illegible] the [illegible] to have the road in operation [illegible] of September next.

[illegible] system of street railway [illegible] in trust to the [illegible] company of Philadelphia to guarantee [illegible] payable in twenty [illegible] With the [illegible] the company will [illegible] of $2[illegible] up the [illegible] power instead of horses, the work of [illegible] immediately.

At a meeting of the Cincinnati Board of Public Affairs last week the request of the Cincinnati Street Railway company for permission to erect poles on Harrison avenue and Bogen street for the purpose of conveying electric wires from the power house to the line of the new [illegible] referred to the engineer, with the request that he notify the company to submit samples of the wire to Prof. French, the city electrician.

The Cleveland Board of Improvements has granted the Cleveland Electrical Time company permission to put up a wire connecting its main office with two hundred clocks about the city. The ordinance granting the Broadway & Newburg Street Railroad company the right to operate its line by electricity, and extending the company's franchise to a period of twenty-five years from the passage of the ordinance, was recommended.

An ordinance has been introduced at the city council of Winona, Minn., at the instance of the Winona City Railway company, which, when passed, will greatly enlarge the company's usefulness in Winona, and extend its operations quite extensively throughout the city. The street railway company has lately been reorganized, and the scheme of the directors, as outlined in the ordinance introduced, is to put in an extensive electric plant to run the street cars by electricity, furnish power for manufactories, elevators, etc., and for lighting purposes. The company proposes, if the ordinance passes, and there is every probability that it will pass, to commence at once on the erection of its poles and plant. By the terms of the ordinance the company is required to commence work inside of six months, and to have everything in running order inside of a year. The plant to be erected is to have ample power to run all the minor factories of the city, besides furnishing the best electric light and running all the cars the city's travel will require for years.

A Cleveland paper says: Steps are being taken by several local business men to organize a new street railroad company. The enterprise, if undertaken, will be backed by New York capital, and the road will be operated with storage battery electric motors. Two meetings have been held by the promoters, and if the consent of property owners along the proposed line can be obtained, the company will soon be incorporated. It is intended to run cars from Water street over the Superior street or East Cleveland rails to Erie street. If the former route is taken, the new line proper will start from the corner of Superior and Erie streets, and run to Euclid avenue. It will go up Euclid to Perry street, and thence to Sibley street, the Cedar avenue line tracks being used for a short distance under the ordinance that permits a railway to use 1,000 feet of a rival company's rails. It will run out Sibley to Wilson avenue, thence to East Prospect street and along that thoroughfare to Bolton avenue. The route will be down Bolton to Wade Park avenue, and eastward on that street to Wade Park.

THE TELEPHONE.

The Erie Telephone company of Fort Worth, Tex., has filed with the district clerk an injunction restraining the city of Fort Worth from levying on its property for taxes. The ground is that the city assesses the franchise for $15,000, which the telephone company says it has no right to do.

George W. Smalley, the famous London correspondent, writes: "The British postoffice and the telephone companies are engaged in an interesting controversy, the first effect of which is to remind the public that the postoffice has from the beginning thrown obstacles in the way of telephoning, claimed and established the legal right to extend its telegraph monopoly to telephones, compelled the companies to work under a postoffice license, exacts 10 per cent. of their profit, and holds over them the power of suspending the license. The telephone companies now propose to amalgamate, and the postoffice steps forward to prevent it. Amalgamation may or may not, be in the public interest, but for the postoffice to resist because it would create a monopoly is comic, the postoffice itself being the largest monopolist in the kingdom and straining its powers to prevent a competition by which the public would benefit."

The London *Globe* says: "On or about April 1st many Continental newspapers contained long accounts of an alleged new and startling invention, which was called a theatrophone. It was described as a device for utilizing the advantages of the telephone in conjunction with those of the automatic delivery system. In coffee houses and other places of general resort were to be placed certain iron boxes, each of which was to be connected, by means of telephone wires, with all the theaters of the town. On a plate was to be the inscription: 'Put a penny in the slot, pull out the delivering funnel, move the index hand to the name of the desired theater, and listen.' Then, it was asserted, you might shut your eyes and imagine that you were in the presence of Got or Bernhardt, or in a stall at the opera. For three blissful minutes you would enjoy the luxury, and then, unless you previously contributed another penny to the machine, the connection would be automatically interrupted. Arrangements, it was stated, were in progress for supplying theatrophones upon easy terms to private houses, and the machine would, it was declared, be on show at the Paris exhibition. There were

[illegible] the [illegible]

THE TELEGRAPH.

[illegible]

[illegible] hour.

The sale of the [illegible] Telegraph [illegible] the Western Union Telegraph company was consummated at Baltimore June 17th, and a [illegible] by the Baltimore & Ohio conveys to the Western [illegible] its right, title and interest in and to all [illegible] and property of every nature and description. The consideration is $[illegible] and the entire discharge of the Baltimore & Ohio Telegraph company from the obligation to issue the $[illegible] bonds provided for [illegible] the Baltimore & Ohio Railroad company.

Miscellaneous Notes.

The corner stone of the Williams Engine Works at Beloit, Wis., was laid June 21st. The structure will be [illegible]x145 feet.

The Electrical Construction company will soon be incorporated at St. Louis with a capital stock of [illegible]. The company now has a contract to reconstruct the plant of the St. Charles Car Works.

The Northwest Electric Construction Supply company of St. Paul will make an elaborate electrical display at the Minneapolis Industrial exposition, which will be held in Minneapolis from August 21st to September 28th.

Personal Paragraphs.

A. H. Patterson, general manager of the [illegible] company, New York, was in Chicago this week.

John H. Finney, of the Fidelity Carbon Manufacturing company of St. Louis, was in Chicago last week.

James F. McQuade, secretary and treasurer of the National Conduit Manufacturing company, New York, was a visitor at the Chicago Electric Club last week.

Francis W. Parker, the well known patent solicitor of Chicago, sails for Europe on the Aurania to-day. He will stop briefly at Manchester and London on his way to the Paris exposition where he will remain till the close of the great event looking after the interests of his clients.

Business Mention.

The Electrical and Machinery company of Detroit, Mich., is making a specialty of electrical apparatus.

Dr. C. H. Holmes has opened an office for general electrical supplies at the Commercial building, St. Louis, and reports an excellent business.

A. C. Kendall, formerly general manager of the Ma[illegible] Storage Battery company, has been appointed special agent of the Daft Electric Light company for New Jersey.

W. Hackenthal of 21 Beekman street, New York, has issued a circular descriptive of Prof. Aron's "electricity counter," which he is manufacturing. The instrument is highly commended, and is having a ready sale.

The Pond Engineering company of St. Louis has just issued a catalogue devoted to pumping machinery for waterworks, in which it describes and illustrates the numerous devices which it manufactures for this particular branch. The catalogue contains much interesting and valuable information.

The New York Insulated Wire company reports brisk business. It is wiring some of the new [illegible] buildings now under construction in New York, among which is the 12-story building of [illegible]. The company has wired all the theaters in the city [illegible] with the exception of the Broadway which was [illegible] done by this company.

The Stilwell & Bierce Manufacturing company of Dayton, O., has just made a shipment of [illegible] turbines and other machinery to the [illegible] company of Neenah, Wis., for the [illegible] paper mill [illegible] This is believed to be the largest [illegible] wheels ever made at one time [illegible].

The Electrical [illegible]

Electrical Patents.

Childs, Engle N. J.

in forming the constituting a con- at the point where the battery cover.

ectric Switch. Olof Dahl, Brooklyn, N. Y.

Brooklyn, N. Y. consists of a thermo- of the heat generat through which the heat passes proportionately with the number of translating devices using current, combined with loading for registering the revolutions of the motor.

Alternating Current Dynamo. Mass.

The invention consists in passing an exciting current through the same field magnet coil, both from the main circuit coil of the machine or that which supplies current to the work and from a separate exciting source, which latter is preferably for the sake of simplicity, on the same armature or in the same field with the work circuit armature coil, although it may be an separate

284. Dynamo-Electric Machine. Frank Thone, Os-

The invention may be described as an armature consisting of a core and longitudinally-wound coils of copper wire encompassing the same, the core consisting of annular heads or end pieces with longitudinal bars connecting said heads, but electrically insulated from one of them, and circumferential windings or wrappings of iron.

Generator. Henry E. Waite, New York, N. Y.

5,345. Process of Electric Welding. Charles L. Coffin, Detroit, Mich.

The invention consists in supplying molten metal to the joint in addition to that supplied by the articles under treatment, for the purpose of reinforcing the joint.

5,365. Electric Railway. Alexander L. Lineff, Westminster, England.

Wiping Device for Wire Galvanizing. Herbert Smith, Worcester, Mass.

Telephone Switch. Alfred Stromberg, Chicago, Ill.

The invention relates to telephone switches, and is especially designed to be used at a subscriber's station to enable the operator to automatically bring the telephone into circuit and close the local battery and transmitter circuit on taking down the telephone, while on hanging up the telephone the bell is brought into the circuit of the telephone line, while at the same time the telephone is removed from said circuit and the local circuit opened.

Electric Meter. Rudolf Diehl, New York, N. and Philip Diehl, Elizabeth, N. J.

Claim 5 reads: "5. The combination of an electro-magnetic device operated upon by the current to be measured, an intermittently-operated friction clutch, and a registering apparatus driven by said friction-clutch at a rate determined by the position or condition of said electro-magnetic device."

5,420. Attachment for Telephones. Hermann Kon-

Regulating Light from Electric Lamps. William H. Melaney, Pittsburg, Pa.

5,436. Electro Medical Belt. William J. Shelton,

Electric Lamp. Elmer A. Sperry, Chicago, Ill.

eighteen claims the fourth and last are given: combination of a moving magnet or solenoid supported on such frame, a carbon rod clamp actuated at one end and attached the latter is af magnet or sole-

lamps, the moving pieces,

while providing that each station shall, when using the line for telephonic conversation, have a clear line unencumbered by interposed electro magnets, that each station shall be enabled to ascertain when the circuit is already being used by another, and that while any one station is using the line none of the others shall be able to disturb the conversation by sending a call signal.

405,468. Street Cable Railway. Henry Flad, St. Louis, Mo.

The object of the invention is to provide means for controlling the movement of the cables by electricity. The invention consists, in the combination, with a track and a car carrying a grip, of a motor for actuating a cable, a permanently charged electric conductor located along the line of railway, and means for admitting power to the motor controlled by an electric circuit, which may be established or broken at pleasure. The invention further consists in a grip, which, in conjunction with a motor, a permanently charged electric conductor, and an auxiliary conductor, will in gripping the cable effect admission of power to the cable motor, and in its releasing of the cable will effect the shutting off of the power from the said motor.

405,471. Apparatus for Generating Electricity. Timothy Gleeson, Brooklyn, N. Y.

405,480. Manufacture of Carbon Filaments. Theophilus V. Hughes, Holywell, North Wales, and Charles R. Chambers, South Kensington, County of Middlesex, England.

The invention is claimed as a process of manufacturing dense homogenous, resilient and hair like carbon filaments for glow lamps, which process consists in causing a gaseous carbon compound (capable of yielding carbon when decomposed by heat) to undergo decomposition in a heated retort, the gases while undergoing the decomposition having such motions impressed upon them that vertical or gyrating currents of gas are set up through the atmosphere of the retort, from which currents the carbon resulting from the decomposition segregates directly in the form of filaments.

405,507. Dynamo-Electric Machine. William D. Sandwell, Herne Hill, County of Surrey, England.

The invention consists in employing two armatures in combination with one set of field magnets, so that after one armature is heated it can be replaced by the other.

405,515. Pilot or Head for Sectional Rods for Threading Underground Conduits. George H. Waide, New York, N. Y.

It has been found that if the wall between two conduits has become ruptured or broken down from any cause, the pilot or head of the advancing rod is liable to pass from the conduit along which it is advanced through the opening into the adjoining conduit, and thus emerge at the next manhole from a conduit other than that which it originally entered. The invention is designed to prevent such an occurrence, and locate the faults or breaks in the conduits.

405,519. Electric Appliance for Railway Switches. Morris Wuerpel, St. Louis, Mo.

405,525. Electric Bell Pull. Charles A. Braun, Chicago, Ill.

405,539. Autographic Telegraphy. Mark W. Dewey, Syracuse, N. Y.

The first and last claims are appended:

"1. In combination with the manipulative instrument and a rod carrying said instrument, a rotary variable resistance operated by the said rod and consisting of a wheel and a path of semi-conducting material extended spirally around said wheel, and an electric contact riding on said semi-conducting material.

"29. In a receiving instrument of an autographic telegraph, having a pen adapted to be moved in all directions, electro-magnets in a line circuit for controlling the movements of said pen in a plane parallel with the writing sheet and corresponding to the movements of the transmitting pen, a pole changer operated by the movements of the handle of the transmitting pen at right angles to the plane of the writing sheet, a relay in the line circuit adapted to respond to the changes in the polarity of the current, and a pen-lifter for moving said pen at right angles to the plane of the writing sheet operated by magnets in local circuit controlled by the movements of said relay."

405,544. Contact Device for Electric Railways. Frank E Fisher, Detroit, Mich.

405,546. Insulator. Robert P. Frist, Wilmington, Del.

The object of the invention is to construct from chemically treated fiber or like non conducting material, a retaining and fastening device for electrical conductors.

Electric Railway. Rudolph M. Hunter, Philadelphia, Pa.

Telephone Attachment. Otto Kongslow, Cleveland, O.

Electric Circuits. Osborn

described as an automatic circuits, consisting in the detector the respective sides magnets metal about and returned on itself an armature for and the lever to in the magnet on the main line. Washing

The second claim reads as follows:

"The combination, in a terra cotta conduit for electric wires, of an inclosing case or tube having a gutter to carry off moisture, a series of superimposed sections built up within said case and having each a central vertical rib and longitudinal ducts or passages on either side of said rib."

405,602. Dynamo Electric Machine or Motor. Conrad L. Rosenquist, Yonkers, N. Y.

The claim is:

"The combination, with the main shaft, of a sleeve of insulating material thereon, said sleeve being reduced in diameter between its extremities, and an armature made up of coils of copper strips surrounding a core of iron wire, the said wire being wound under tension and bending the copper strips toward the shaft and against the surface of the sleeve, whereby the armature is prevented from slipping off the sleeve."

405,604. Production of Copper by Electrolysis. Alberto Rovello, Turin, Italy.

405,609. Galvanic Battery. James Serson, Boston, Mass.

405,621. Key. Clarence W. Taylor, Jaresville, Wis.

The invention consists in the combination, with a telegraph instrument, of a vibrating lever mounted therein, a sliding plate having a longitudinal slot carried on the lever, a weight suspended from the sliding plate and provided with a longitudinal slot and a set screw adapted to pass through the slot in the sliding plate and into the lever to retain said plate at any desired adjustment.

405,626. Slotted Conduit for Electrical Conductors. Charles J. Van Depoele, Chicago, Ill.

A traveling contact device is provided extending downward through the slot and into contact with both the conductors, and said device is supported upon a pair of metallic wheels or shoes resting and traveling upon exposed portions of the conduit.

405,627. Switch for Suspended Electric Conductors. Charles J. Van Depoele, Lynn, Mass.

Claim 9 follows:

"A switch for suspended electric conductors, comprising a rib or member for each conductor, each member being formed with an opening to receive the extremity of the conductor, and with a rib or part extending from the said openings, forming continuations of the conductor to carry the contact device to the point of divergence.

405,628. Closed Slotted Conduit for Electric Railways. Charles J. Van Depoele, Lynn, Mass.

Of the eighteen claims the fourth is given:

"A closed conduit comprising a slotted metallic casing extending along the line of way, a slotted insulated lining within said chamber, a main supply conductor supported by said insulating lining, flexible insulating strips arranged on the under side of each side of the slot between the metallic casing and the interior insulation, the adjacent edges of said strips being normally in contact to close the same, and a traveling contact device engaging the conductor, and a thin plate or extension connected to the contact and extending upward between the edges of the slot-closing strips."

405,646. Electrical Primer. Edmund L. Zalinski, United States Army, and Henry J. Smith, Pompton, N. J.

405,647. Delay-Action Primer. Edmund L. Zalinski, United States Army, and Henry J. Smith, Pompton, N. J.

405,668. Electric Motor or Dynamo-Electric Machine. Rudolph M. Hunter, Philadelphia, Pa.

It has been found that an electric motor may be advantageously made with an armature composed of two sets of coils, each set of which is connected with separate commutators, because by this construction the motor may be more thoroughly regulated by varying the internal resistance of the armature and the number of coils in circuit. The invention consists in an electrically-propelled car, a motor geared to the axle and having field magnets and a rotating armature core, in combination with two sets of coils of insulated wire wrapped about said core and substantially uniformly distributed and independently insulated, a commutator at each end of the armature, each having its contact segments connected to alternate coils, two pairs of brushes, one pair for each commutator, a source of electric supply and connecting circuits between its field magnets, commutator brushes and source of electric supply whereby the field magnets are permanently in series with the armature and source of electric supply.

405,677. Telephone Combination Circuit. Frank A. Pickernell, East Orange, N. J.

The fifth claim reads:

"5. In a telephone exchange system, the combination of two lines, each extending from a central station through the sub-station of the other to a normal earth terminal at its own sub station, a normally open branch circuit at each sub-station, including the telephones of the said sub-station, the said branch being in permanent connection at one end with the line of the other sub station, as described and automatically operated means at each station for disconnecting the earth terminals of both lines, and for connecting the disconnected terminals of its own line with the normally open end of the telephone branch, whereby a metallic circuit including the telephone is established."

405,682. Semaphore Signal. Jens G. Schreuder, Pittsburg, Pa.

405,684. Electric Primer. Henry J. Smith, Pompton, N. J., and Edmund L. Zalinski, United States Army.

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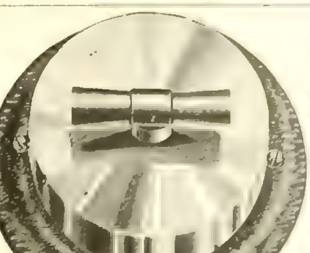

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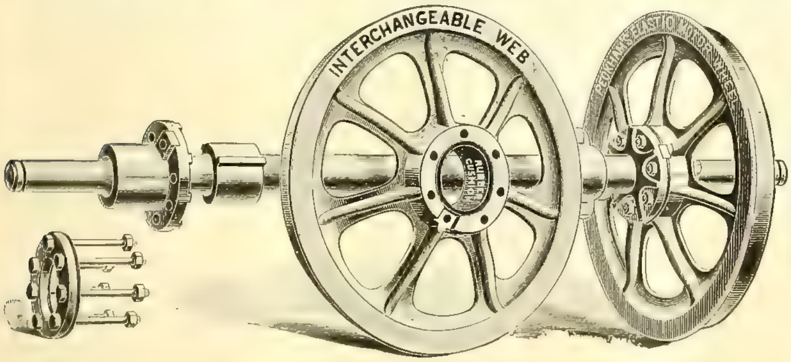

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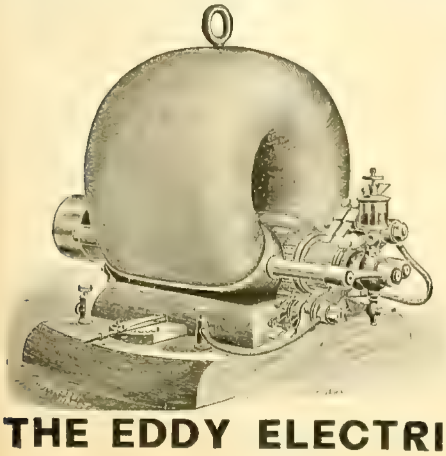

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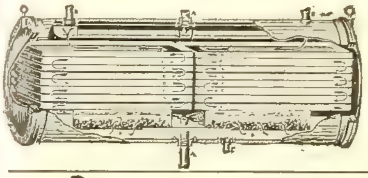

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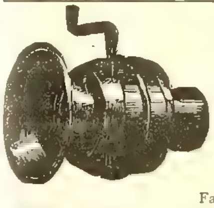

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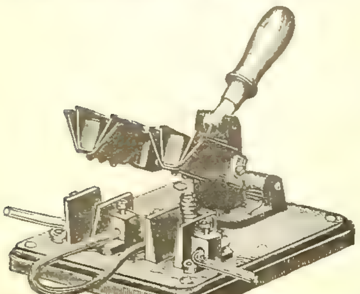

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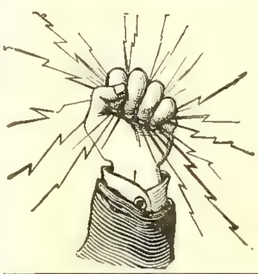

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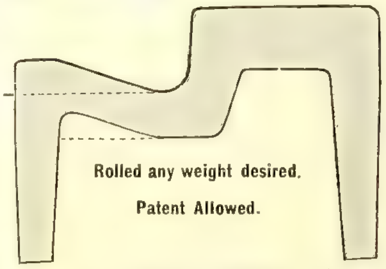

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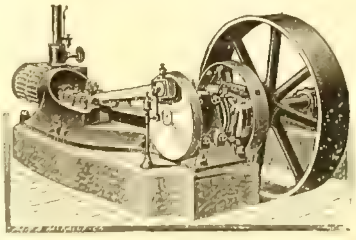

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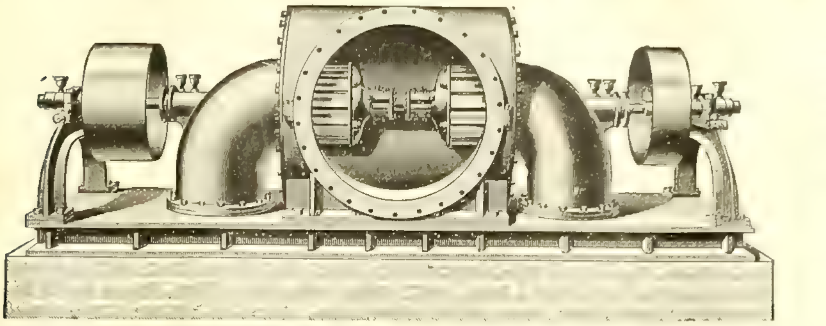

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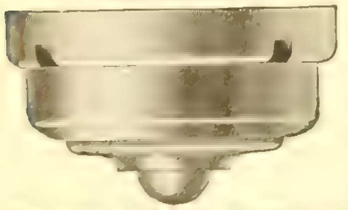

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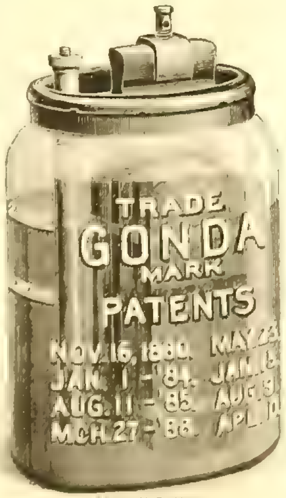

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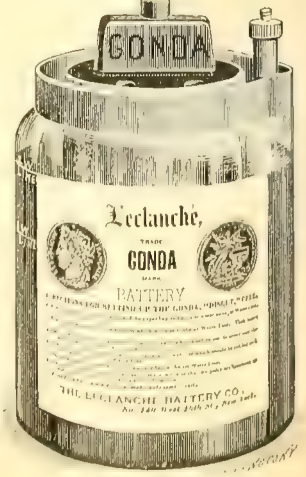

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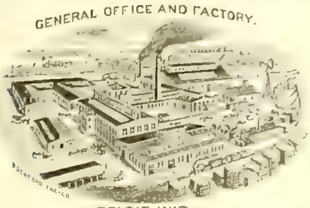

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- The Multiple Arc System.
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- Cleat Work.
- Molding Work.
- Concealed Work.
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  - b. In a Completed Building.

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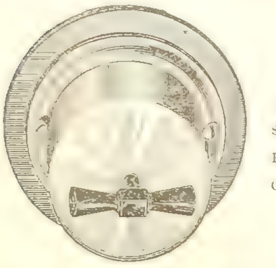

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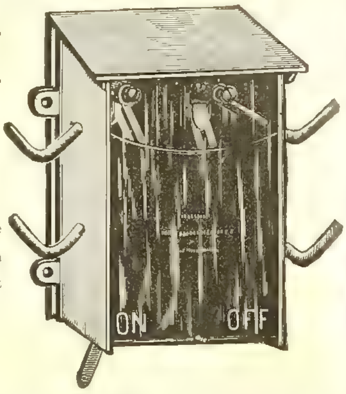

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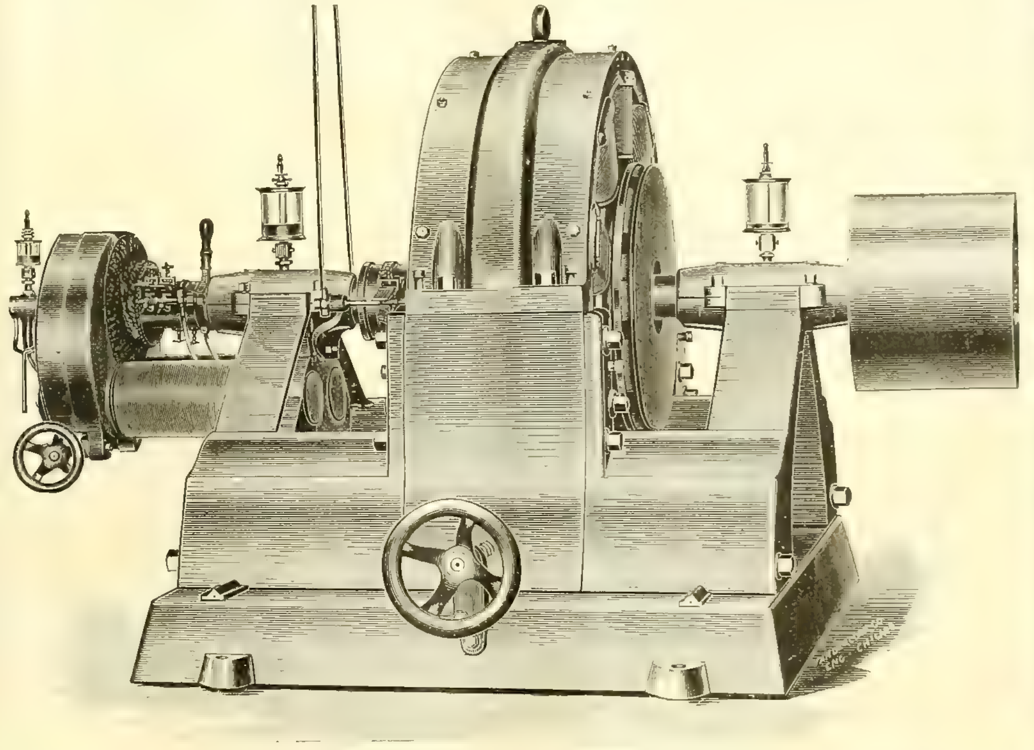

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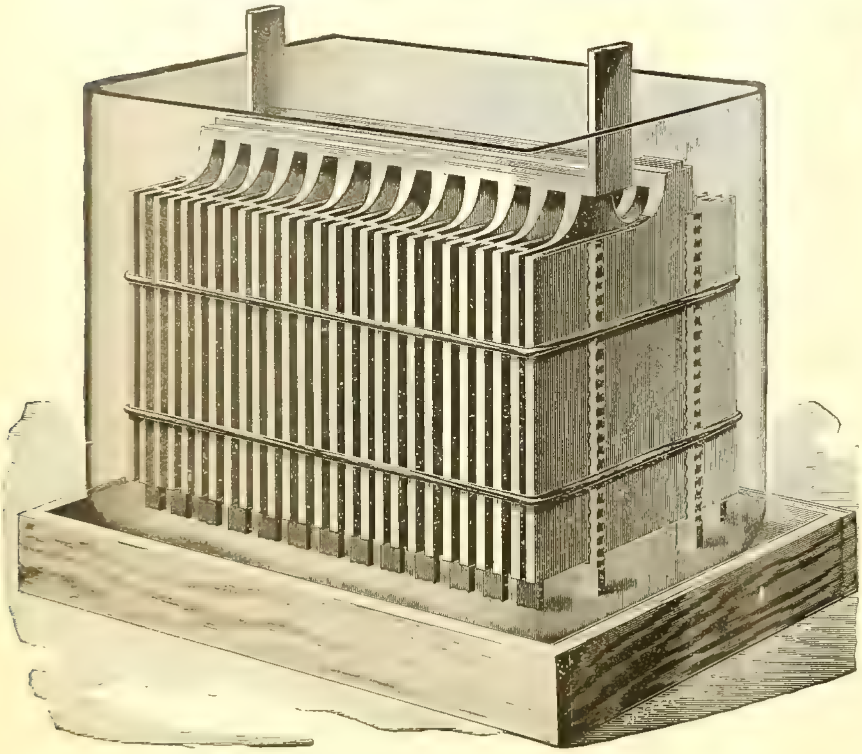

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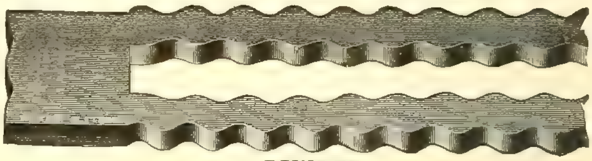

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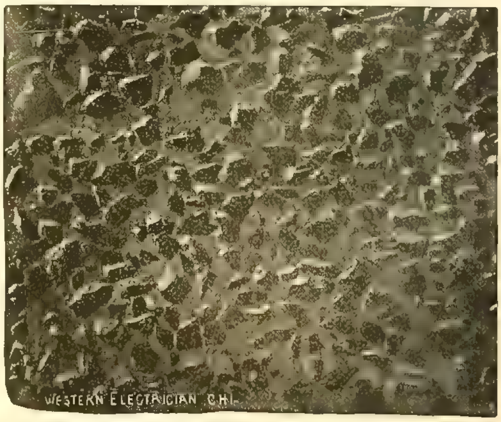

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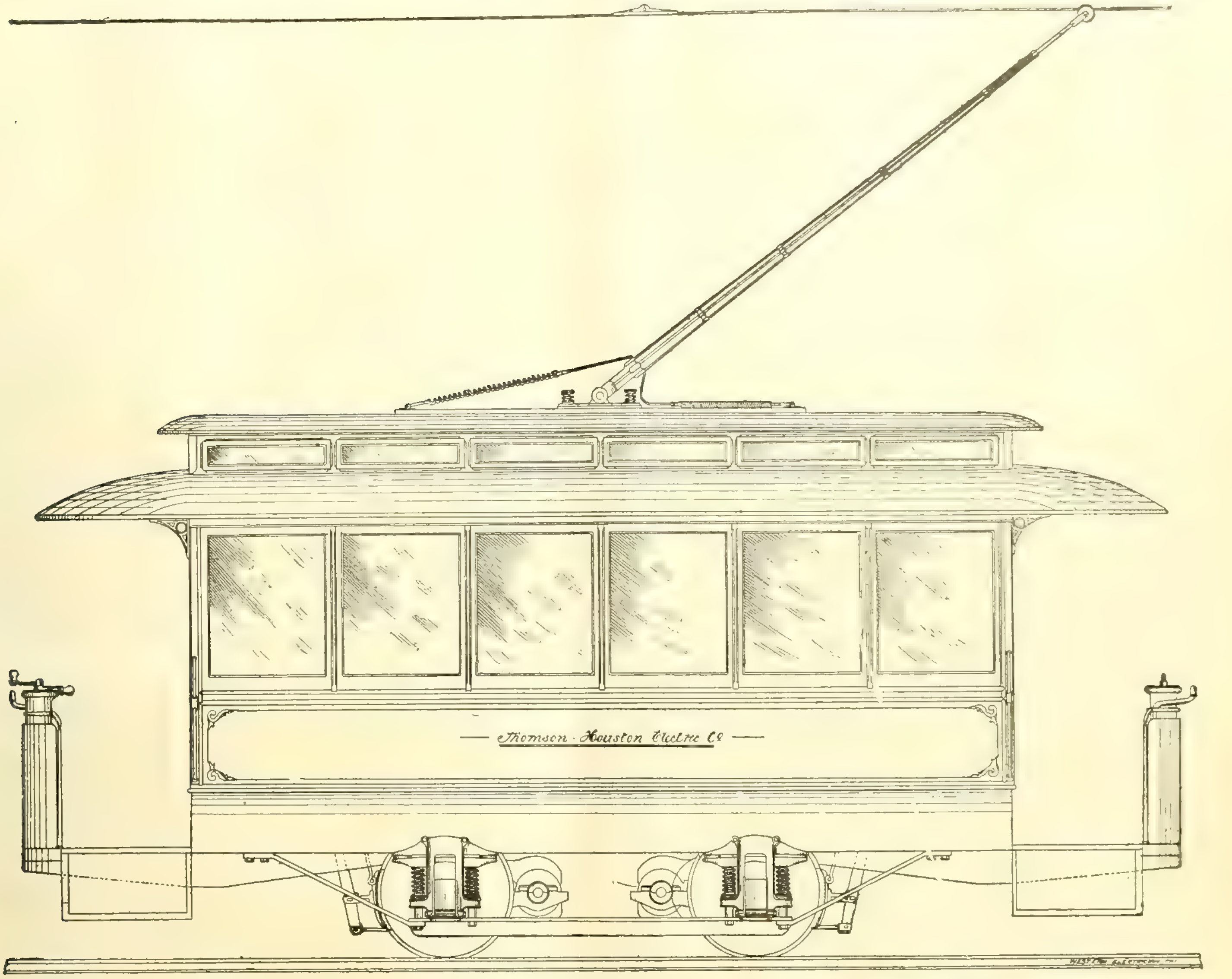

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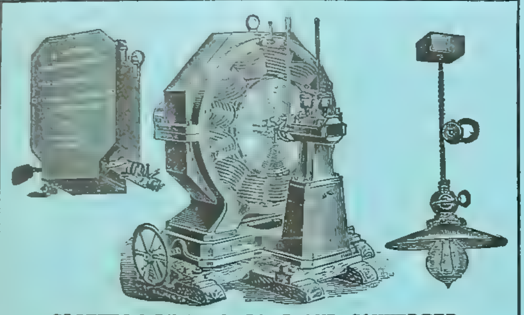

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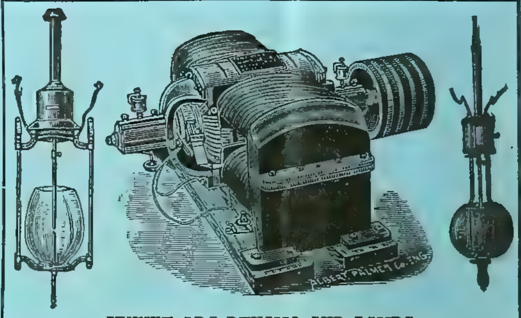

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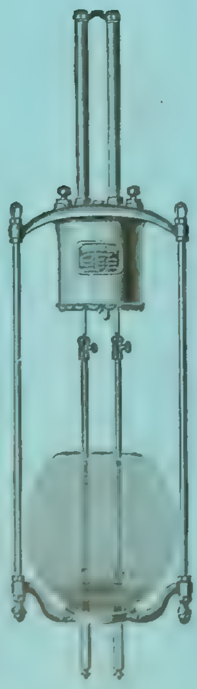

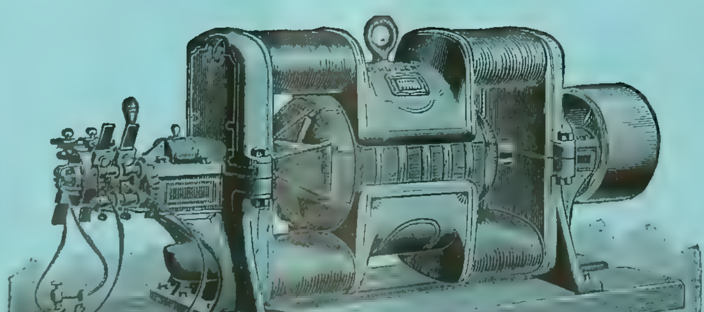

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